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Apply Powdered Coal to Air Furnace

Malleable-Iron Melting Furnaces and Annealing Ovens Have Been Converted from Hand-Firing to the Use of Powdered Coal Without Involving Radical Changes in Design

BY PAT DWYER

THE output of any furnace, whether that furnace is designed for melting, annealing or reheating, is dependent on three factors: the maintenance of proper temperature, the furnace design and the human factor. To maintain a temperature as required by the particular heating process necessitates that the proper amount of heat be generated. The quantity of fuel needed to generate this heat will depend on the degree of approach to perfect combustion. The design of the furnace will determine the efficiency of application of this heat and hence, in a large measure, the amount of fuel. Unless a furnace is handled intelligently there will be a waste of fuel, and the output, other factors being constant, will be in direct ratio to the intelligence shown.

It is claimed by impartial investigators that where the furnace design has been correct the use of powdered coal as a fuel invariably has given an increased production as compared with that obtained from the fuel supplanted. This largely has been due to the fact that powdered coal affords opportunity to obtain a thorough combination of air and fuel and produces a high degree of efficient combustion. Where failure has resulted it has been caused in the majority of cases by applications to furnaces built for other fuels and not altered; or in furnaces designed with insufficient knowledge of the application of powdered coal. The labor cost connected with handling and preparing coal

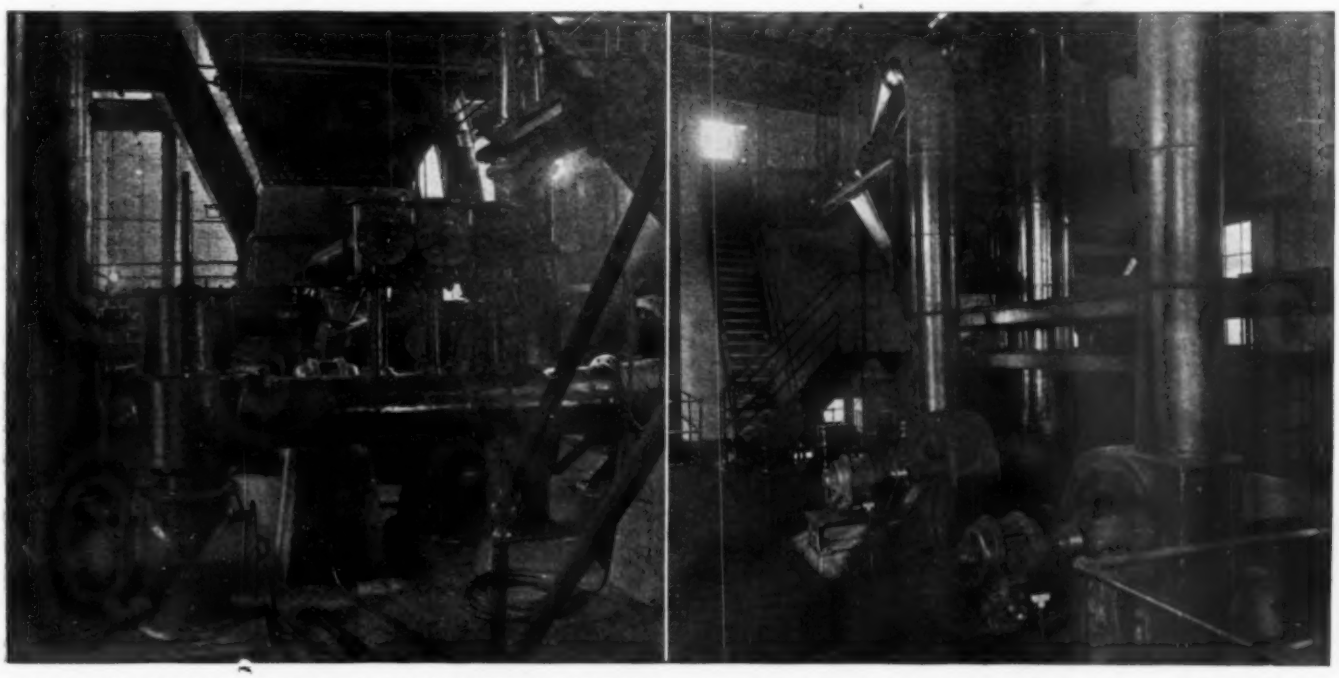

FIG. 1—THE STORAGE HOPPER HAS A CAPACITY OF 25 TONS THE POWDERED COAL IS TAKEN FROM THE BOTTOM OF THE HOPPER AND FED INTO A POWERFUL SUCTION FAN WHICH SUPPLIES THE MAIN PIPE FIG. 2—FANS USED TO CONVEY THE POWDERED COAL FROM THE PULVERIZERS TO THE STORAGE BINS

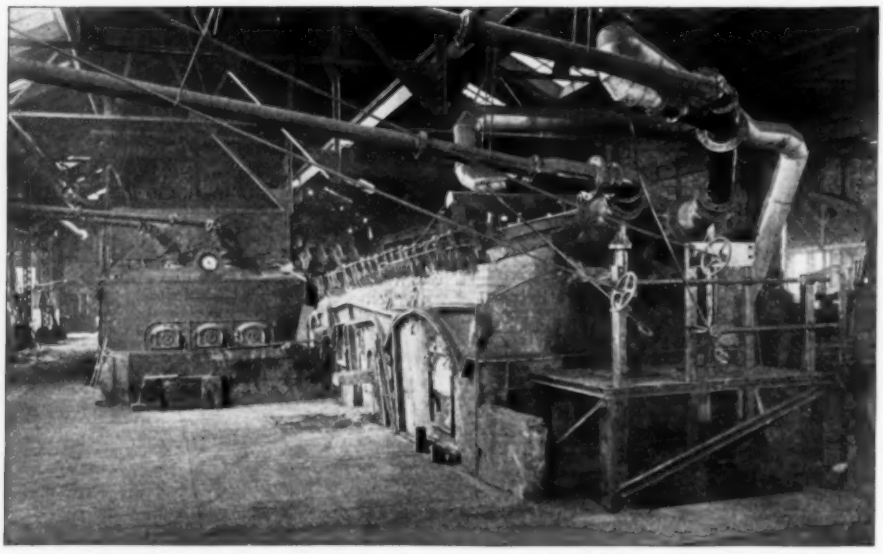

FIG. 3—GENERAL ARRANGEMENT OF PIPING AT THE FIRING END OF ONE OF THE MELTING FURNACES—WASTE HEAT FROM THE FURNACE IS UTILIZED TO FIRE THE BOILER SHOWN AT THE LEFT

will include drying, pulverizing and conveying to the burners, but in almost all cases it is stated that this cost is lower than the cost of delivering coal by hand or power to hand-fired furnaces.

In the malleable iron foundry a high temperature is required for melting the charge and annealing the castings. The usual furnace efficiency in each case is low and opportunity is thus afforded to effect a considerable reduction in the fuel consumption. In attempting to secure a more efficient and economical heating method, powdered coal has been used in quite a number of annealing ovens, but up to the present little has been done in the way of installing powdered coal equipment in connection with malleable melting furnaces.

Early Applications

The credit for the success of the first installation using powdered coal in a malleable annealing oven belongs to the late B. J. Walker, who applied the method at the plant of the Erie Malleable Iron Co., Erie, Pa., in 1896. At the present time some 20 malleable foundries burn powdered coal in their annealing furnaces with satisfactory results.

A fluctuating temperature must be avoided in annealing malleable castings and in addition the temperature must be held for a definite period within well defined limits. To secure this control of the heat requires close regulation of both the fuel and the air used to burn it. With powdered coal as a fuel it is claimed that the temperature throughout the oven is kept nearly uniform. This is accounted for by the fact that the gases in the furnace usually are under a slight pressure.

Powdered coal as a fuel medium for melting malleable iron as yet has not been adopted to any great extent, although the success attained in a few notable installations would seem to indicate that it is both feasible and economical The first essential of a furnace fired with powdered coal—a large combustion chamber where the flame can occupy about four times the volume of the flame produced by an ordinary grate fire—would seem to indicate that the reverberatory type of furnace is well suited to the use of powdered coal. In all cases the fuel must be projected into a chamber sufficiently hot to cause instant deflagration. The furnace must be properly proportioned, properly equipped and in good condition.

The Marion Malleable Iron Works, Marion, Ind., is unique in that it not only employs powdered coal in its melting furnaces and annealing ovens, but also because instead of the usual screw conveyors in the feed lines the Holbeck air-distributing system has been adopted. It was erected and installed by the Bonnot Co., Canton, O., and may briefly be described as follows:

The crushing, grinding and storage plant is shown in Fig. 4. Immediately in front of the building a large, rectangular concrete hopper has been provided under the track to receive the coal on its way to the grinder The hopper has a capacity of several cars and when convenient the coal cars are shunted over the opening and dumped. However, usually the coal is taken from the storage pile, shown to the right of the illustration, by a grab bucket attached to the hook of a locomotive crane.

Crushing the Coal

From the track hopper the coal is discharged into a crusher by means of a reciprocating feeder. The crusher reduces the coal to small particles. It is then taken from the crusher and elevated by bucket elevator to a sixty ton coal bunker. Coal is fed from this bunker onto a belt conveyor and passes through an automatic weighing scale into a screw conveyor which conveys the coal into the end of the dryer. Particles of iron and steel are removed by a magnetic separator supported above the belt,

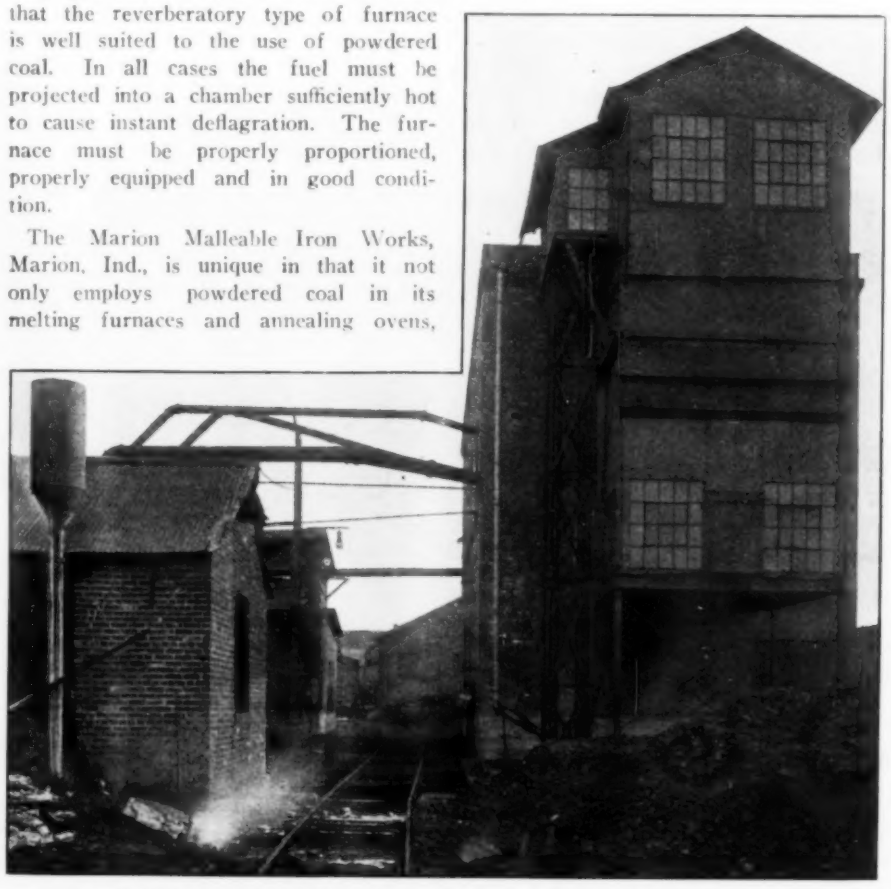

FIG. 4—EXTERIOR ARRANGEMENT OF THE POWDERED COAL PLANT

which conveys the coal from the bunker to the automatic weighing scale.

The pulverizer consists of a heavy one-piece main frame which contains the grinding parts consisting of grinding rolls and roll-head or driver.

The driving ring stands vertically and is held in place by two large clamp bolts extending through to the rear of the base. The rolls revolve around the inner side of the ring and are held in place and driven by the head or driver. The driver is recessed to receive the rolls and is so shaped as to converge the coal on the track in front of the rolls. It is a high carbon steel casting with hard wearing surfaces. A cover plate is bolted over a large opening in one side of the main frame through which the driver, rolls and grinding ring may be removed without disturbing other parts.

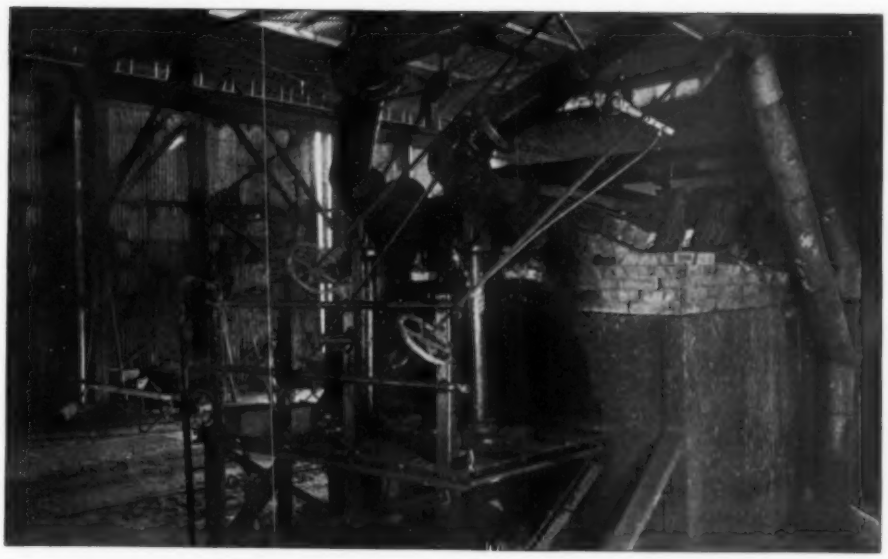

FIG. 6—MELTER'S PLATFORM SHOWING VALVE CONTROLS USED IN REGULATING THE AIR AND COAL MIXTURE THAT GOES INTO THE FURNACE—THE POWDERED COAL MAIN IS LOCATED OVERHEAD WHILE THE MAIN AIR PIPE IS LAID UNDERGROUND

From Pulverizer to Separator

This pulverizer is particularly adapted to use with a separator, owing to the fact that the grinding parts revolve in a vertical plane and throw a constant stream of ground coal upward against the separator. The base of the separator is attached to the top of the grinding chamber and is made with the sides flaring or diverging so as to form a large air chamber into which the coal is thrown in a constant stream by the grinding parts. The air current entering at the bottom of the separator passes upward and carries away the fine material. Because of the increased area toward the top of the separator the velocity of the air current is there reduced. This allows the coarser material to fall back into the grinding chamber while the fine material is carried upward.

A feature of this separator is an interior flue on each side by which a considerable range of fineness may be secured. These flues are hinged at the bottom and adjusted by a lever on the outside of the separator. To obtain a fine product the flues are inclined outward to a position parallel with the walls of the separator; while for obtaining a coarse product they are set in a vertical position. It is possible without changing the speed of the fan to obtain a range of fineness from 98 per cent through a 200-mesh sieve and practically all through a 100-mesh sieve, to a product of which 50 per cent will pass a 100-mesh sieve and the remainder range in size up to a 16-mesh and even coarser. The velocity of the air current and the position of the flues will determine the degree of fineness. The air current carrying the impalpable material passes from the separator through a pipe to the collector, entering the latter on the side in a horizontal direction.

Air Distribution

The present equipment comprises two pulverizers, each having a capacity of 1¼ tons an hour. It is proposed to increase this equipment by the installation of additional units which will bring the capacity up to 7½ tons an hour.

After the coal has been pulverized and separated it is collected in two large bins which are the only ones in the entire plant in which coal is stored. Air is the agent employed for conveying the coal from these storage bins to the furnaces and ovens. The bottom of the hoppers, together with the exhaust fan and motor and some of the piping, is shown in Fig. 1, while the fans and some of the piping employed for conveying coal from the pulverizers to the separators are shown in Fig. 2. In each case the fan is driven by a direct-connected 10-horsepower General Electric motor.

The powdered coal is taken from this bin by a double-flight screw conveyor driven by a variable speed motor, and then is fed into the suction side of a high-pressure blower. From this it is blown into the distributing main and carried to the furnaces and annealing ovens through branch pipes. The coal

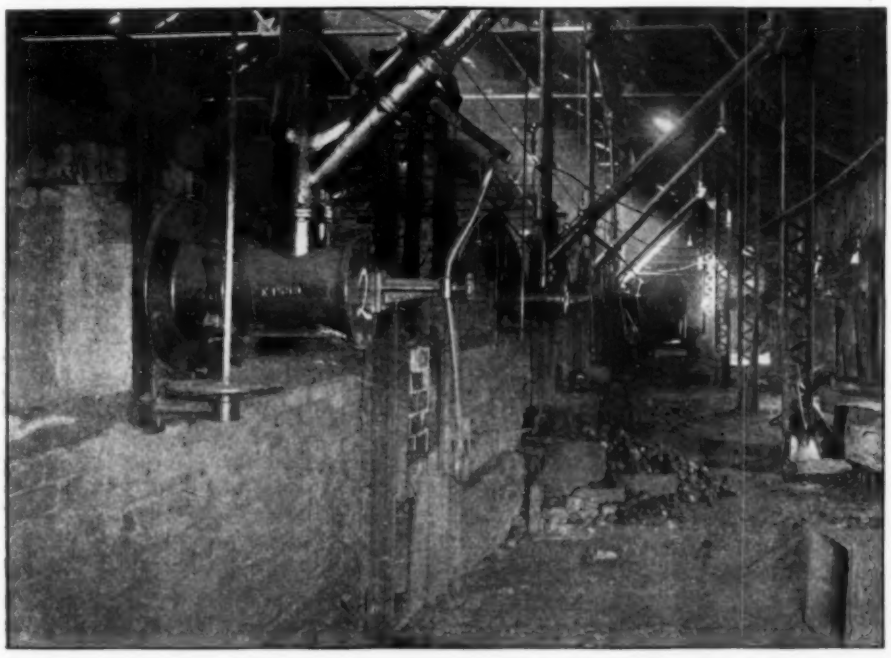

FIG. 5—THE POWDERED COAL AND AUXILIARY AIR SUPPLY ARE UNITED IN ANY DESIRED PROPORTION IN A MIXING CHAMBER BEFORE ENTERING THE BURNER

which is not used at the furnaces is returned through another line to a collector located on top of the powdered coal bin, where it is extracted from the air and falls into the storage bin to be used over again. The air from the return line after the coal has been extracted is returned to the suction side of the distributing blower.

Interposed in the distributing main is a special flow indicator and controller; intended first to indicate the rate of flow of air through the system and, second, to control the feed of powdered coal into the system so as to have a uniform mixture of coal dust and air to the burners, regardless of the number of furnaces in operation. The return line permits a velocity of air in the distributing main sufficiently high to keep the powdered coal in suspension in the air and in circulation in the system even with no furnaces in operation.

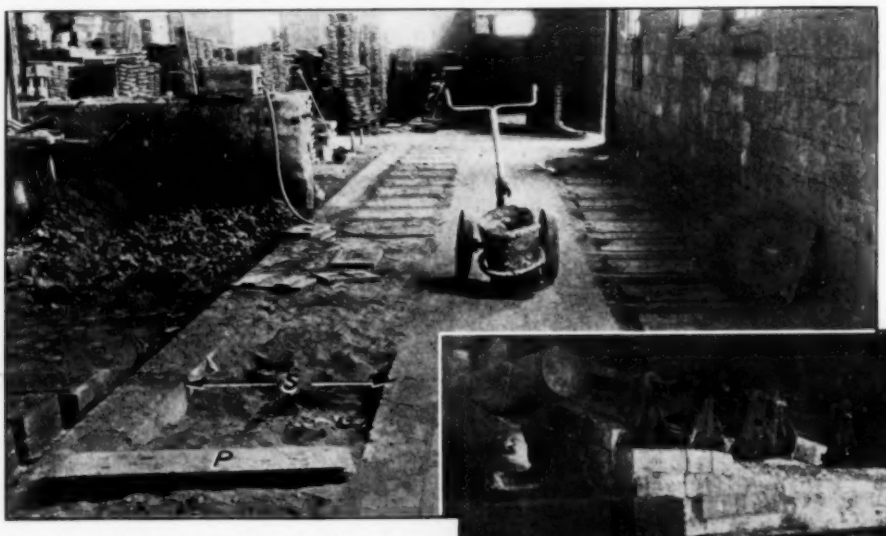

FIG. 7—MOLDS FOR ANNEALING POTS ARE MADE IN THE FLOOR ON BOTH SIDES OF A CONCRETE GANGWAY

Automatic Control

When the valves in the branches at the furnaces are opened so as to permit a flow of coal dust to the burners there is an increase in the flow of air through the flow indicator. This increased flow is instantly indicated on a dial provided for that purpose. At the same time a small pilot motor is started and by means of proper gearing the arm of a special field rheostat is moved in proportion to the increase in the flow of air through the distributing mains. This rheostat controls the variable speed motor that drives the feed screw, thus speeding up this motor and feeding more coal dust to meet the demand. In case a valve of the furnace should be partly closed, thus causing a decrease in the flow of air through the system, the pilot motor is automatically reversed, the rheostat arm is moved in the opposite direction and the motor driving the feed screw is slowed down so that the mixture of coal dust and air automatically is kept uniform.

With this system the powdered coal can be conveyed any reasonable distance. If the velocity of flow is reduced, due to friction in the main, a second or even a third and fourth distributing blower or booster can be placed in the line and thus the circulation can be kept up for an indefinite distance. In the Marion plant two boosters are employed—one in the annealing room, and one in the new foundry, which contains two melting furnaces.

Air distribution entirely eliminates the storage bin at each individual furnace, something that will be appreciated in cases where space is limited or where it can be used to better advantage. It also eliminates the *hanging up* of coal dust at the furnaces, a feature which may cause avalanching and flushing past the controllers, causing the furnace to puff and in extreme cases smothering the fire.

No coal dust is left in storage in the works or at the furnaces. Within a few minutes after the furnaces are shut off all of the coal dust in the distributing system has been returned to the pulverizer coal plant.

With this system of distribution it was not necessary to build a large special combustion chamber, neither were the existing furnaces changed to any great extent. The pipe connections at the end of one of the melting furnaces are shown in Figs. 2 and 6 and the general arrangement at the back of a battery of annealing ovens is shown in Fig. 5. Two burners are employed in each of the furnaces, but one in each of the annealing ovens has given satisfactory service.

Method of Carburetion

It will be noted in each of these illustrations that before the main pipe enters the burner it is joined by a second. This second pipe is connected with an air line and serves to regulate the density of the coal dust and air entering the furnace or oven. The coal dust in the distributing main is held in suspension in the proportion of 50 to 1. It has been found that to obtain the highest efficiency a mixture of 200 to 1 is necessary. By means of the hand wheels and handles, clearly shown in the illustration, the valves in the coal dust and air pipes can be controlled to a nicety and the volume and intensity of the flame regulated to any degree within the limit of the equipment. In addition to helping dilute the coal dust and air supply one of the branch pipes in each furnace is connected to a header which supplies air through the roof of the furnace at a point corresponding to the bridge wall in a hand-fired furnace. The waste heat from

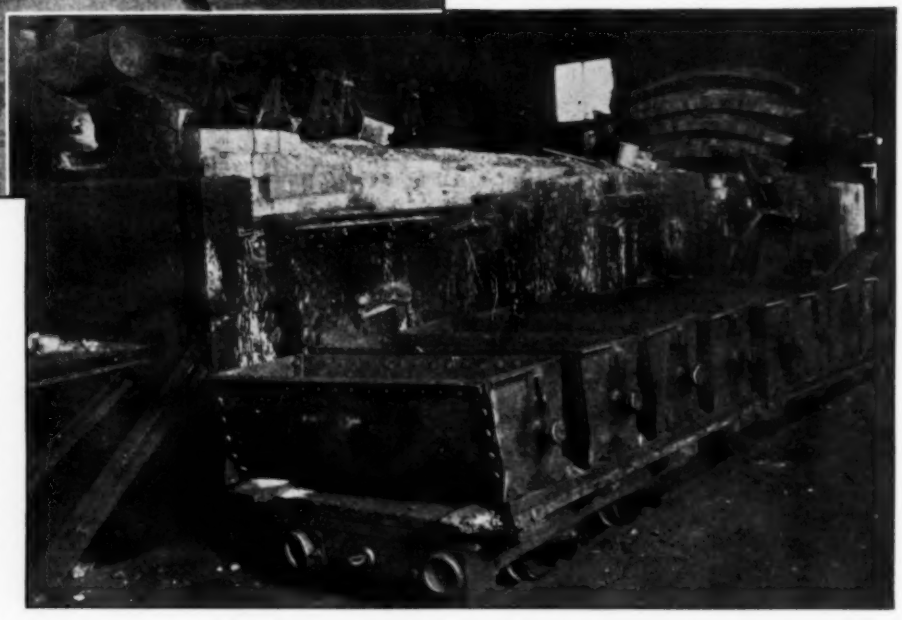

FIG. 8—THE FURNACE CHARGES ARE MADE UP IN PANS AND DUMPED INTO THE FURNACE BY AN OVERHEAD TRAVELING CRANE

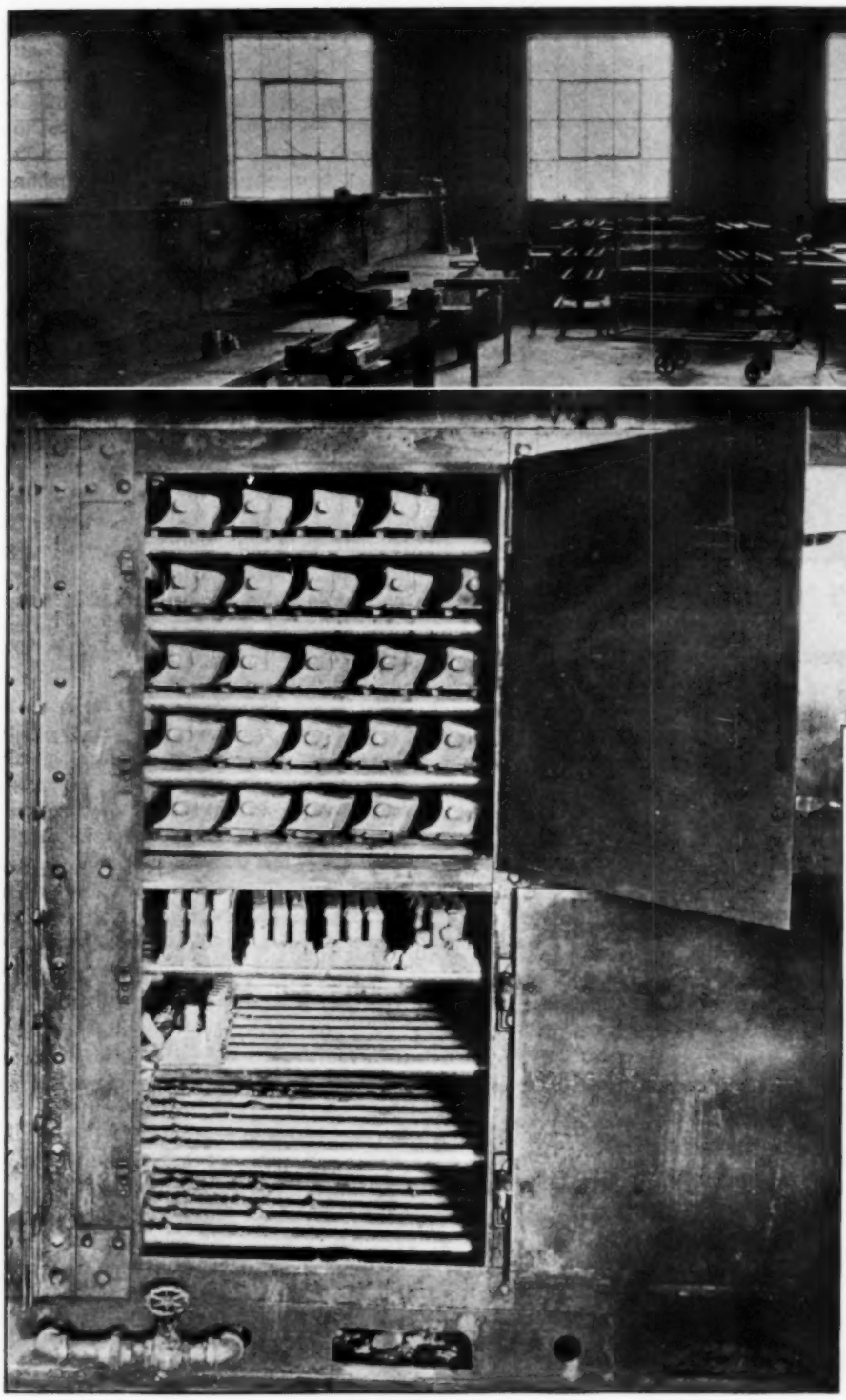

FIG. 9—CLOSE UP OF OVENS SHOWING DETAILS OF CONSTRUCTION OF PLATE FRONT, HINGES, CATCHES AND STEAM COIL SHELVES

the furnace shown in Fig. 3 is employed to fire the boiler shown to the left of the same illustration, and the steam from the boiler is used for many purposes which are touched upon later.

The Chicago Railway Equipment Co., with a head office and an assembling plant in Chicago, controls the Marion Malleable Iron Works, and in addition operates a rolling mill in Franklin, Pa. a malleable iron foundry in Grand Rapids, Mich., and an assembling plant in Montreal, Canada. The Marion plant, provided with four 25-ton and one 16-ton furnaces, pouring four or five heats per day, has a daily melting capacity of over 100 tons. As the average of sprue to castings is about 50-50, a little more than 50 tons of castings can be produced a day, or approximately 1000 tons a month. Under normal conditions about 30 per cent of the capacity is devoted to work for the assembling plants of the company and the other

FIG. 10—THE BENCHES IN THE CORE ROOM ARE ARRANGED IN PAIRS AT RIGHT ANGLES TO THE OVENS

70 per cent is made up of general jobbing work, with a tendency to lean to the automotive field.

The plant buildings cover about 10 of the 14 acres comprising the company's property on the outskirts of the city and include, in addition to the powdered coal building, two self-contained molding and casting shops, a core room,

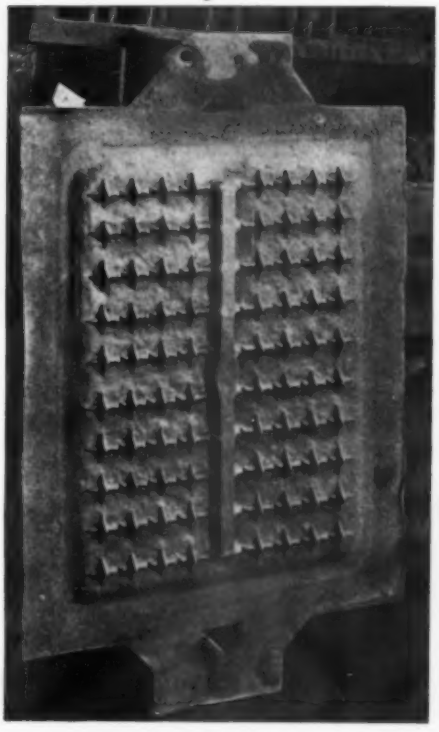

FIG. 11—A HARD STAR MATCH PLATE

FIG. 12—A DOUBLE DECK BATTERY OF 72 OVENS IN WHICH THE CORES ARE DRIED BY STEAM HEAT

a carpenter and repair shop, a pattern shop, a power house, cleaning and shipping room, general office and a new 3-story welfare building. The latter, a handsome brick and concrete structure, has a general store on the first floor, where employes can buy groceries, etc., at reasonable prices. The second floor is fitted up with hot and cold water, wash basins and shower baths, and individual lockers in which the employes can keep their changes of clothing. The third floor has been equipped as a cafeteria, where the men can procure a noon meal at actual cost of the food. The cost incidental to the preparation of the food and to looking after the dishes and equipment is borne by the company.

Old and New Foundry

The so-called old shop is equipped with three furnaces, two having a capacity of 50 tons a day and the other 30 tons. It was enlarged on several occasions and finally when the floors had been extended to an economical limit from the furnaces a new building was erected and equipped with two 25-ton furnaces. The walls of the new building were constructed of concrete blocks with a temporary wall at one end to permit of extension. It has been extended recently, the extension taking the form of the steel frame factory construction building, with ample lighting and ventilating features. Also further extension is contemplated.

The molding methods employed conform to the standards usual in foundries of this character. In addition to the floors on which molds are made by hand on the floor and on the bench, the old foundry is equipped with 35 power squeezer machines made by the Osborn Mfg. Co., Cleveland; while 38 duplicate machines are installed in the new foundry. In addition there are 17 machines made by the International Molding Machine Co., Chicago, and one made by the Federal Malleable Co., West Allis, Wis.

The metal matchplates used on these machines, together with other miscellaneus wood and metal patterns, are made in an extensive pattern shop maintained by the company on the premises. An improvement on the ordinary matchplate used for making the stars employed in cleaning the castings is illustrated in Fig. 11. It will be noted that there are 80 star patterns on the plate arranged in 10 rows with 4 patterns on each side of the long center runner. This arrangement economizes in the total amount of iron required to pour these castings. The only metal wasted in gates is that in the central runner. The patterns in each group of four touch each other without any intervening gate metal. When these castings are poured and shaken out they are not broken off the gates singly, but are broken off in groups of fours and thrown into the tumbling barrels in that shape. After one or two revolutions in the tumbling barrels they are reduced to single stars.

Annealing Pots

A space is set apart in each foundry in which to make the annealing pot castings. The floor devoted to this purpose in one end of the new foundry is shown in Fig. 7. The two long and narrow sand pits in which the castings are molded are disposed on both sides of a concrete gangway which extends from one side of the building to the other and connects with the two longitudinal gangways which extend from one end of the building to the other. The pots are molded and cast in open-sand molds as shown, any surplus metal from the furnaces being employed for this purpose. Notches similar to the pair shown at *S*, Fig 7, are let into the concrete walls forming the sides of the casting pits. Stout pieces of plank, *P*, Fig. 7, are dropped into these notches and serve to reinforce the body of sand separating one pot mold from its neighbor. The one-man bogie ladle shown in the same illustration is employed for pouring the pot castings. No basin or runner-cup is used. The metal is poured directly into one of the end walls.

The furnaces are charged through the roof, each furnace being served by an individual traveling crane for that purpose. The charge is made up in the yard and shunted in alongside the furnaces loaded on 4-pan trucks as illustrated in Fig. 8. In the yard the pans are either loaded directly by a locomotive crane equipped with a magnet or they are lifted off the trucks by

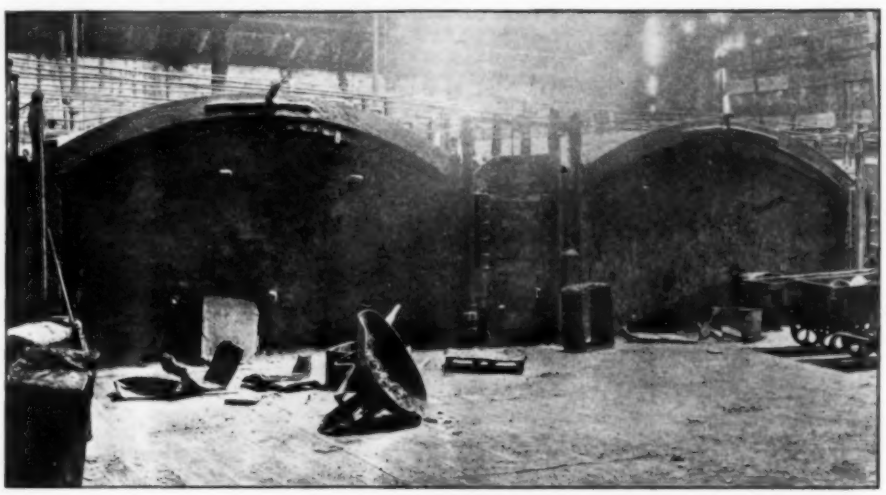

FIG. 13—FRONT SIDE OF TWO OF THE 14 ANNEALING OVENS IN THE BATTERY—EACH OVEN HAS A CAPACITY OF 270 POTS

the crane and set in a convenient position near the stock pile, to be loaded by hand. Standard practice is observed in mixing and melting the iron, and test wedges are taken from every heat in accordance with the practice recommended by the American Malleable Castings association, of which the company is a member. With powdered coal as a fuel it is stated that the melting ratio is approximately 1 to 4.

Core Room and Core Ovens

The core room, three views of which are shown in Figs. 9, 10 and 12, is housed in a building 50 x 150 feet. The walls are of brick and the corrugated sheet iron roof is supported on a steel frame. Besides the windows in the walls additional windows inserted at numerous points in the roof afford ample light. The floor construction, a typical pair of benches, and a few of the trucks employed for carrying the cores to and from the ovens, are shown in Fig. 10. The floor is formed of smooth concrete, a feature which makes for cleanliness as well as affording facility for the operation of trucks. However, a narrow plank floor has been inlaid close to and parallel to each bench for the girl coremakers to stand upon.

In front of each coremakers station at the bench a small flat iron plate is laid. The coreboxes are set and rammed on this plate. At the back and a little to one side a stand is provided on which to set the plate of green cores. The coremakers do nothing but ram the cores and set them on the plates. A man delegated for the purpose collects the plates, loads them on a light truck and takes them to the ovens.

The general arrangement of the double-deck battery of 72 ovens is shown in Fig. 12, and the details of construction of one oven is shown in Fig. 9. A sheet-iron hood, built out over the doors, serves to collect the fumes, gas and smoke incident to the drying process and discharges them through 11 suitable pipes projecting through openings in the roof. The steam generated from the green cores in the ovens is drawn off through a number of small pipes which converge and unite in three large upright pipes also projecting through the roof. These may be seen against the wall in Fig 12.

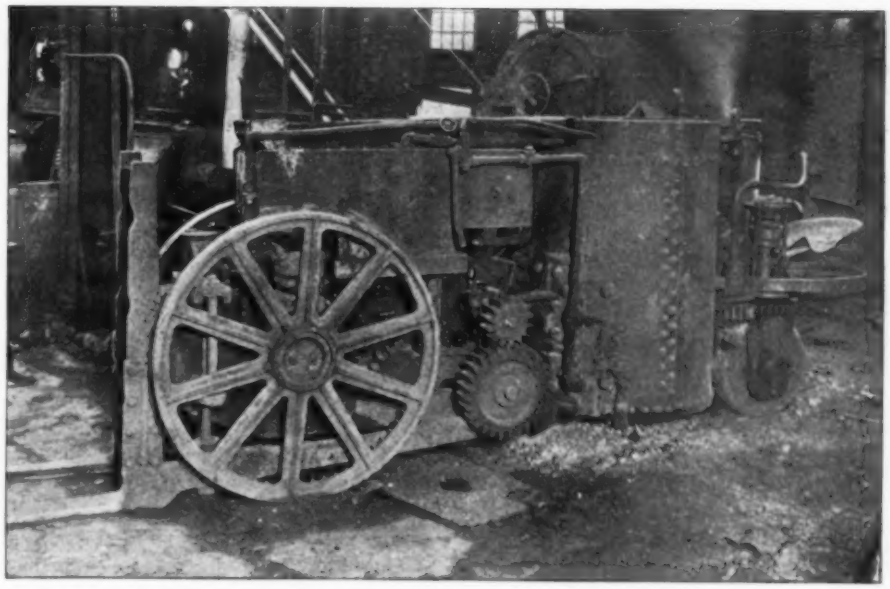

FIG. 15—STEAM DRIVEN CHARGING CAR FOR LOADING AND UNLOADING OVENS

Steam-Heated Core Ovens

Steam from the waste-heat boiler previously referred to is employed to dry the cores. Each shelf in the oven is formed of steam coils as shown in Fig. 9. It is an easy and simple arrangement. The heat is bound to be uniform throughout the oven and it never can reach a temperature high enough to burn or scorch the cores. After the cores have been dried they are taken out, loaded onto trucks similar to those employed for taking the green cores to the ovens, and wheeled to a number of benches surrounding an open space in the core room. Here they are unloaded, sorted and packed into small wooden boxes, in which they are taken to the molding shops.

An oil-sand mixture is used for all the cores. One 6-foot grinding pan made by the National Engineering Co., Chicago, is employed for mixing the core sand. It is loaded by bucket elevator and the requisite amount of oil for a batch of sand is added while the mill is revolving. A space at the end of the core room has been set apart as a store room. In addition it is equipped with a wire-straightening and cutting machine for preparing the wires and rods for the coremakers.

Repair Department Complete

A carpenter shop, 50 x 250, adjoins the core room at right angles. Approximately half this space is devoted to the tools and equipment necessary for making and repairing the flasks, bottom boards, slip-jackets and other miscellaneous jobs around the plant. The other half of the building is used as a lumber storage and also as a store room in which to keep the follow-boards, match-plates and other rigging of a like character. A basement extending under the entire building is utilized as a sand storage and has a capacity of 80 carloads. A wide belt conveyor passing under a hopper on the outside of the building, into which the sand is dumped, extends to the opposite end of the building. The basement is partitioned into a number of bins designed to keep the different grades of sand separated, and

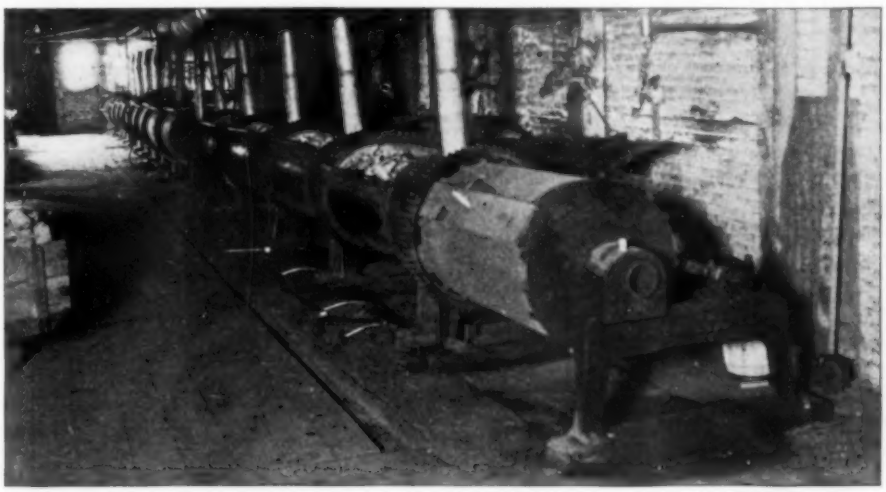

FIG. 14—BEFORE GOING TO THE ANNEALING OVENS THE CASTINGS ARE CLEANED IN A BATTERY OF 15 TUMBLING BARRELS PROVIDED WITH SMALL JIB CRANES FOR HANDLING THE DOORS AND CONNECTED WITH A DUST EXHAUSTING SYSTEM

the sand is diverted into any one of these bins by lowering a suitable stop or plough at any given point.

The power house situated close to the carpenter shop is equipped with the necessary appliances for supplying air and electric current throughout the plant. These include one direct steam-driven Ingersoll-Rand air compressor having a capacity of 446 cubic feet each per minute; two motor generator sets for converting alternating current into direct current for the cranes and magnet; several steam-driven pumps and an installation for softening the water before it enters the boiler.

After the castings have been shaken out and the gates knocked off they are cleaned in the battery of 15 *hard iron* tumbling barrels, shown in Fig. 14. They are known as *hard iron* tumblers to distinguish them from the barrels in which the castings are tumbled after they have been annealed. The barrels are all suitably piped to a large main leading to a dust arrester. A small swinging jib crane is attached to the wall back of each barrel and facilitates the removal and replacement of the cover. The entire battery is driven from one common shaft, but by a suitable clutch arrangement it is possible to disengage any of the barrels at any time without interfering with the operation of the remainder.

The 16 annealing ovens—14 large and 2 small—are housed in a steel-frame, brick-walled building, 80 x 200 feet. The floor in front of the ovens is composed of concrete, while the floor at the back is laid in brick. The view back of the ovens shown in Fig. 5 was taken before the powdered coal installation was placed in operation, which accounts for the piles of coal in front of each firing door. At present the fire doors are bricked up. The brick fireplaces inside the ovens also have been removed, leaving room for several additional pots in each of the ovens. As will be noted in the illustration, Fig. 5, the powdered coal burner enters the oven near the center of the arch and close to the roof. The openings in the lower part of the side walls leading to the flues under the floor have not been changed.

Since the powdered coal was adopted for a fuel it is claimed the ovens can be raised to the annealing temperature of 1600 degrees Fahr. in about 18 hours. Formerly, under the hand-fired system, it required approximately 72 hours.

The self-propelled steam-charging car shown in Fig. 15 is employed for conveying the loaded pots to and from the ovens. It is strong, rugged and heavy and functions at a working pressure of 130 pounds. Each oven holds 270 pots arranged in four rows 15 pots in length, the two outer rows 4 pots high and the two inner rows 5 pots high. In loading or unloading the ovens the charging car picks up the entire tier of 4 or 5 pots at one time. After the castings have been annealed they are cleaned in a battery of tumbling barrels located across the floor from the oven doors. Some of the smaller castings are cleaned in a revolving sand-blast barrel supplied by the New Haven Sand Blast Co., New Haven, Conn. From the cleaning room they are taken to an adjoining building, where they are sorted, weighed, tagged and shipped.

Officials for the British Foundry Exhibit

A COMPLETE organization has now been formed to manage the exhibition of foundry and shop equipment which will be held in Birmingham, England, June 15-24, 1922, under the auspices of the Institution of British Foundrymen, and the British Cast Iron Research association. As previously announced, the exhibition will be conducted by the Birmingham Chamber of Commerce, to act in conjunction with which a strong board of management representing the foundry interests of the world has been selected.

The board consists of a group of general officers and an executive committee. A technical advisory committee also has been appointed.

The general officers are headed by Lord Weir, G. & J. Weir, Ltd., Glasgow, who will be president, assisted by the following vice presidents: Vice Admiral Sir George Goodwin, London; Sir James McKechnie, Vickers, Ltd., Barrow; Douglas Vickers, Sheffield; A. Laing, Wallsend-on-Tyne; P. W. Petter, Yeovil; Dr. J. E. Stead, president, British Iron and Steel Institute, Middlebrough; and M. Deacon, Chesterfield.

The executive committee includes the following: H. Lankin-Smith, Impey Cudworth, Lakin-Smith & Goode, Birmingham *Chairman;* H. C. Field, A. Field & Co., London and Birmingham; J. P. Archurch,, Parker Winder & Archurch, Ltd., Birmingham; J. P. Burman, Burman,Cooper & Co., Ltd., Birmingham; W. Deakin, Machinists, Ltd., Birmingham; L. G. Gould, Birmingham; F. Hickinbotham, Rabone Bros. & Co., Birmingham; W. Mills, Mills Munitions, Ltd., Birmingham; H. E. Parkes, E. Parkes & Co., Ltd., Birmingham; J. Percy Plant, Manifoldia, Ltd., West Bromwich; George Truner, J. E. Wright, Ltd., Aston; G. C. Vyle, W. & T. Avery, Ltd., Smethwick; J. Weatherhead, Barclay's Bank, Ltd., Birmingham; H. O. Warrall, H. O. Warrall & Co., Ltd., Birmingham; V. C. Faulkner, *Foundry Trade Journal,* London; C. Heggie, Brookes (Oldbury) Ltd., Oldbury; H. H. Moore, Herbert Morris, Ltd., Loughborough; W. A. Oubridge, British Piston Ring Co., Ltd., Coventry; H. L. Reason, United Brassfounders, Ltd., Birmingham; D. Howard Wood, Constructional Engineering Co., Ltd., Birmingham; J. E. Fletcher, director, British Cast Iron Research association; Thos. Vickers, secretary, British Cast Iron Research association; H. B. Weeks, Vickers, Ltd., Barrow; Emile Ramas, president, L' Association Technique de Founderie de France, Paris; Joseph Leonard, president, Association technique de Fonderie de Liege, Liege, Belgium; and H. Cole Estep, THE FOUNDRY, London.

The technical advisory committee includes: J. E. Fletcher, *chairman,* F. J. Cook, Rudge, Littley, Ltd., West Bromwich; Col. W. F. Cheesewright *Iron & Coal Trades Review,* London; H. Field, John Harper & Co., Ltd., Willenhall; W. J. Foster, Foster & Bradley, Ltd., Darlaston; J. T. Goodwin, Sheepbridge Iron Co., Ltd., Chesterfield; C. Heggie, Brookes, Ltd., Oldbury; D. Lewis, John Harper & Co., Ltd., Willenhall; W. B. Parker, British Thomson-Houston, Ltd., Rugby; C. B. Pugh, secretary, Staffordshire Iron and Steel Institute, Walsall; H. L. Reason, Birmingham; C. Scampton, Britannia Moulding Machine Co., Ltd., Coventry; D. Howard Wood, Birmingham; E. N. Wright, E. N. Wright, Ltd., Wolverhampton; E. Miller, Incandescent Heat Co., Ltd., Birmingham; E. A. Smith, Birmingham; and Thomas Vickers, Birmingham.

The committees will have their headquarters at the Birmingham Chamber of Commerce, New Street, Birmingham. It is intended to ask the Duke of York to formally open the exhibition and there is every probability the invitation will be accepted.

The enterprise has been taken up with great enthusiam and it is expected the demand for space will greatly exceed the accommodation available. The minimum number of exhibits is estimated at 300. American displays will have considerable prominence and Belgium and France will be well represented.

Manufacturing Firm Builds Plant

Stock Brought from Yard to an Extended Platform—Cupola in Center of the Foundry Which Is Equipped with Rollover, Jolt Molding Machines—Electrically Heated Core Ovens Installed

SUCCESS or failure in business often is determined by a man's ability to forecast the conditions of the future. Practically every one knows the present status of affairs, but only a few are able to estimate the future, and of these not all have the courage to act on their convictions. Conditions during the past year have been such as to discourage building or expansion of plant capacity; but a few who have visualized active business in the near future have set their plants in order to handle the work which eventually must come.

Among these is the McMyler-Interstate Co., located at Bedford, O., a suburb of Cleveland. This company sold the gray-iron foundry which it operated at Warren, O., and started to build a foundry at its Bedford works, in the meantime purchasing the gray-iron castings needed in its manufacturing operations. This new shop is now almost ready for operation and work will be started in it as soon as business becomes more nearly normal.

The building is of steel frame construction having low concrete curtain walls, and steel sash supplied by the David Lupton's Sons Co., Philadelphia. The roof is formed of concrete slabs covered with waterproof roofing. Ventilation is secured through the monitor above the center of the foundry and through hinged steel-plate doors above the curtain wall as shown at *A*, Fig. 2. These doors can be closed tightly in the winter.

Cupola Centrally Located

The foundry building is 105 x 200 feet with a 42½ x 50-foot extension for the cleaning room and another addition 28½ x 50 feet to act as sand storage. Fig. 1 shows the arrangement of the foundry. The cupola may be noted in the center of the shop. The heavy floor work is molded in the bay in front of the cupola, and the section to the left behind the cupola is devoted to light work. The coreroom is shown to the right of the cupola in the rear, while the cleaning and shipping department is located at the extreme right. This arrangement was decided upon so that the foundry could be extended at both ends without any serious disarrangement of the plans. Thus, in the event of extension the cupolas will remain in the center of the shop and the heavy molding, light molding and core and cleaning departments will all be extended in relatively the same proportions.

Pig iron, sand and other materials will be brought to the stock yard in freight cars and unloaded by magnet or grab bucket. To accomplish this, the stock yard is covered for a distance of 350 feet by a 10-ton gantry crane with a 60-foot span. Sand is lifted by a grab bucket and dropped through a hole in the extended platform shown to the left in Fig. 2. From here it falls to the sand storage below. A section of this is shown in Fig. 5. The core sand is kept in

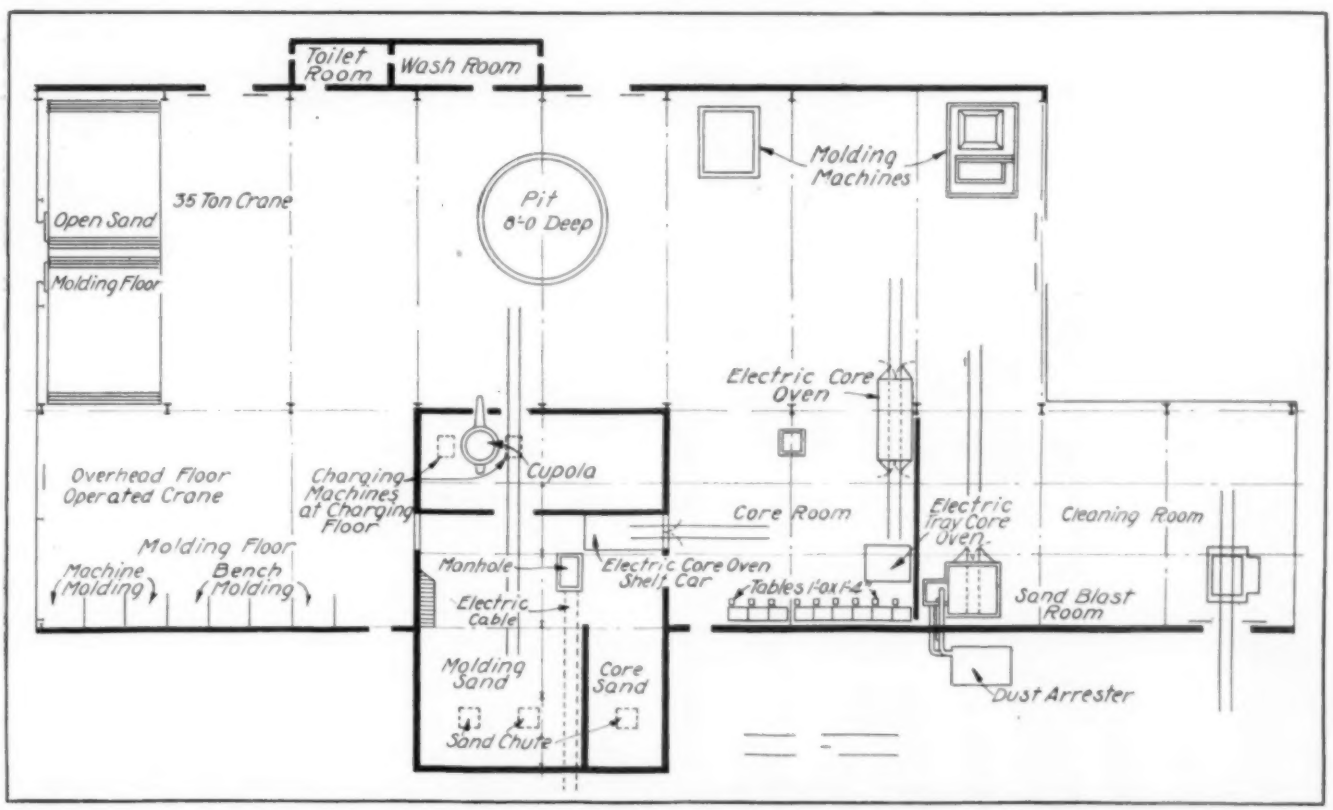

FIG. 1—THE CUPOLA IS LOCATED NEAR THE CENTER OF THE FOUNDRY—THE MOLDING BAY FOR HEAVY WORK IS EQUIPPED WITH A CASTING PIT AND TWO FLOORS FOR OPEN-SAND MOLDING

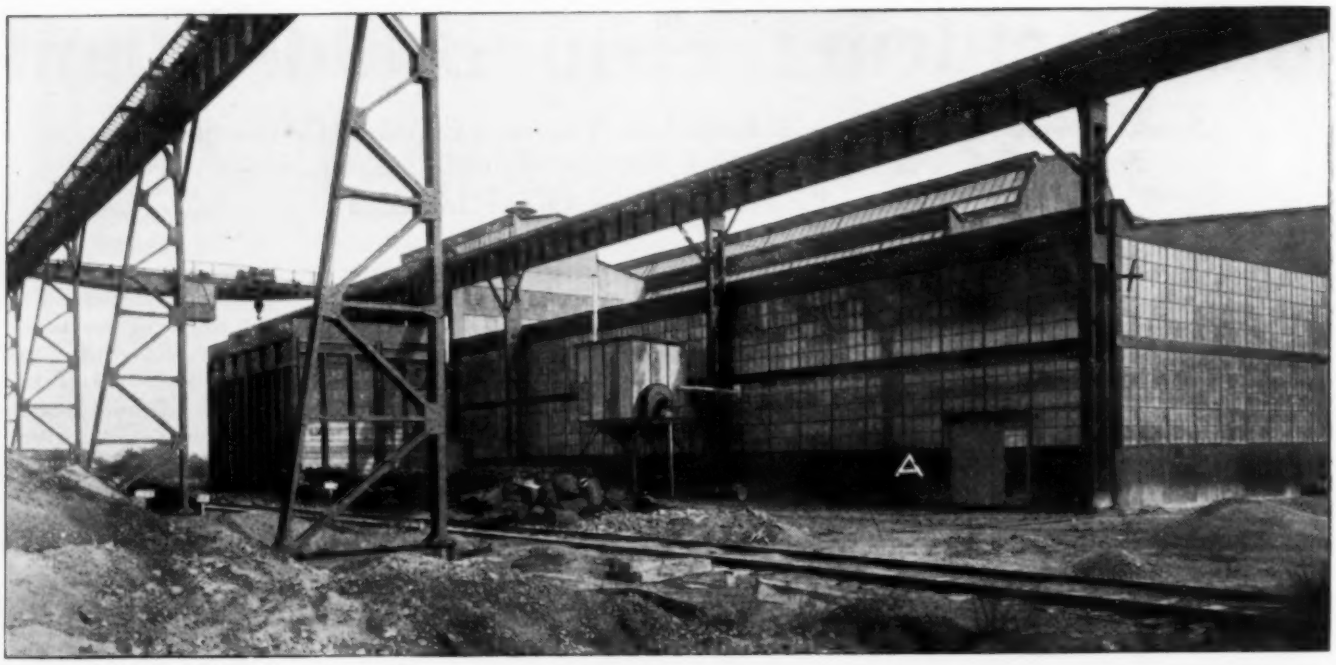

FIG. 2—STOCK IS CARRIED BY A GANTRY CRANE TO AN EXTENDED PLATFORM BACK OF THE CUPOLA

the section to the left of the wooden partition and the molding sand is stored in the larger bin to the right.

Pig iron will be lifted by magnets to the extension platform which is 50 feet wide and extends 28 feet 5 inches from the building. This platform, together with the charging floor of equal dimensions inside the building, provides ample storage for several days supply of coke and pig iron. Coke will be shoveled into skips and elevated to the platform by the crane. The height of the platform is such that, should the crane be out of service at any time, materials may be raised to the platform by a locomotive crane with a goose-neck boom.

Although the shop is designed for two cupolas, only one has been installed. This is 72 inches in diameter lined to 54 inches. Both the cupola and the charging equipment were supplied by the Whiting Corp., Harvey, Ill. The two blowers, located on the mezzanine floor below the charging platform, were furnished by the General Electric Co., Schenectady, N. Y. Only one of these is needed to operate the cupola, the second one being installed for emergency operation.

FIG. 4—THE COMPANY FOR A NUMBER OF YEARS HAS MAINTAINED A LARGE PATTERN SHOP

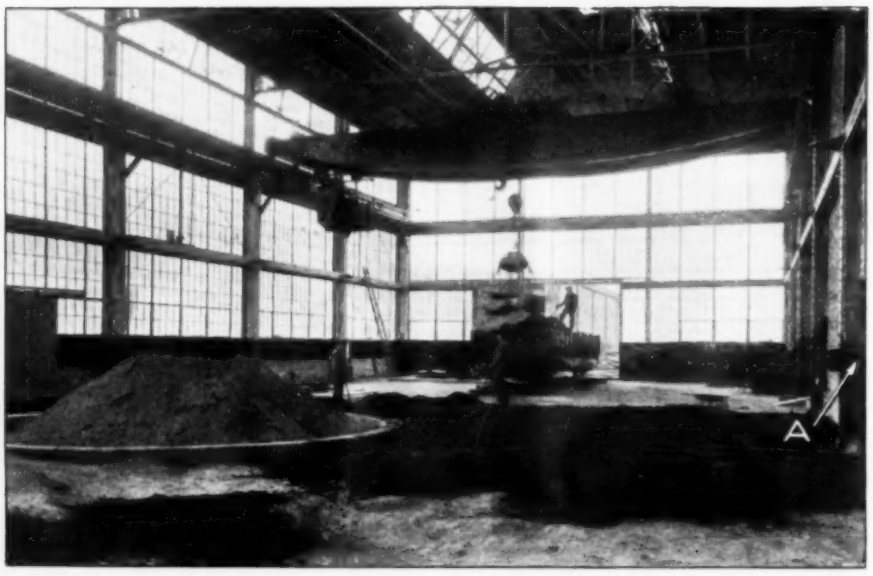

FIG. 3—MAIN MOLDING BAY BEING PREPARED FOR WORK—SAND IS SPREAD OVER THE FLOOR, BEING CARRIED FROM THE CAR BY A GRAB BUCKET

A 35-ton crane with a 10-ton auxiliary hoist has been installed in the bay in front of the cupola, and besides handling flasks and molds it also will carry the metal to the molds. This crane, as well as the other cranes in the shop, were made by the

McMyler company which is a manufacturer of cranes of all kinds.

A portion of this bay is shown in Fig. 3. In this illustration the molding sand is being leveled on the floor. It is brought to the shop in gondola cars and carried to the floor by a grab bucket.

The mound of sand to the left in the illustration is above the molding pit which is 8 feet deep and 25 feet in diameter. The bottom is formed of coke and the side walls, which are 12 inches thick, are built of common red brick. Two rollover-jolt molding machines of the pattern-draw type built by the Herman Pneumatic Machine Co., Pittsburgh, have been installed in the main bay. Multiple work for locomotive crane castings and similar molds will be made on these machines both of which can handle heavy molds. The smaller machine has a jolt capacity of 5 tons and a rollover capacity of 1½ tons, while the heavier machine can jolt 15 tons and rollover 5 tons. Jobs which are above the rollover capacity can be jolted and then handled with the crane.

Smaller Machines Installed

Besides these two larger machines, three smaller units have been installed One is a rollover machine with an 18-inch square table built by the Tabor Mfg. Co., Philadelphia, and the other two are of the squeezer type, furnished by the U. S. Molding Machine Co., Cleveland.

Considerable open-sand work will be done and two floors 25 x 25 feet have been provided at one end of the main bay. A rail is laid in concrete on two opposite sides of each floor and, being carefully aligned, these rails serve as supports for the leveling rail which is slid over the top of them.

As has been said, the section devoted to molding small work is to the left at the rear of the cupola. This section which is 42½ x 125 feet, has a cement floor instead of a sand floor as is in the main bay. It is served by a 5-ton electrically operated crane having floor control. The core room on the opposite side of the cupola is 42½ x 75 feet. This is convenient to the sand storage bin and two sand mixers built by the Blystone Mfg. Co., Cambridge Springs, Pa. serve to prepare the sand for the coremakers. At the start two core machines will be used; the one a 24 x 24-inch jar machine made by the Herman Pneumatic Machine Co., and the other a machine built by the Wadsworth Core Machine & Equipment Co., Akron, O.

A novel departure has been made in the method for baking the cores. Three electrically heated ovens designed and built by the McMyler company are installed. The heating elements, which were furnished by the General Electric Co., are arranged in eight circuits and any number of these circuits may be closed to heat the oven. The interior of one of the ovens is shown in Fig. 5. Some of the heating elements may be noted on the left-hand wall. The electrical control is on a switch board at the left of the oven as is also a recording thermometer for indicating the temperature. Tracks are laid on the floor of the oven so that a truck or car may be used. The walls and doors are built of a double thickness of steel plate with heat-insulating material between. One of the other ovens is of the double-end, car type and trays will be used in the third oven.

As may be noted from Fig. 1, the cleaning and shipping department joins one end of the main molding bay. The track extending from the sandblast room into the main bay, will be used to bring castings into the cleaning room. Here they may be handled by a 5-ton crane similar to the one in the light-molding department. Castings will be cleaned in a sandblast room or a tumbling mill both of which were built by the W. W. Sly Mfg. Co., Cleveland. A 15-ton car-type scale and a 1000-pound platform scale are located near the exit of the shipping department.

Locker and wash rooms are provided for the workmen. The office is in the pattern-storage building which is 48½ x 125 feet and built of fireproof construction. The third building connected with the foundry work is the pattern shop, a view of the interior of which is shown in Fig. 4. This building which has been used for the same purpose for a number of years is 70 x 181 feet and of frame construction.

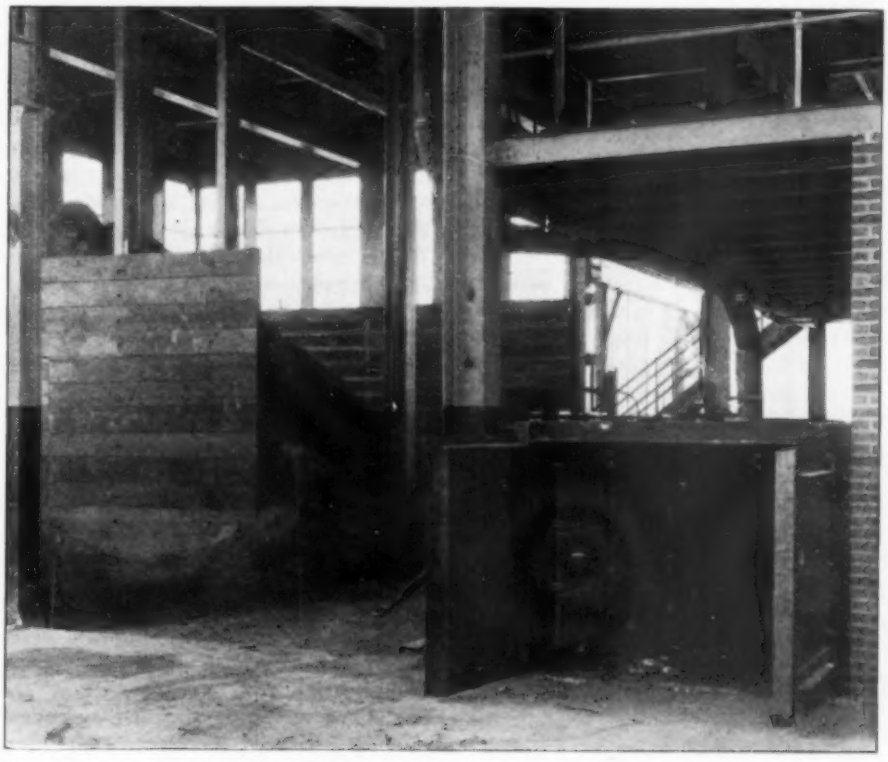

FIG. 5—SAND IS DROPPED THROUGH HOLES IN THE FLOOR OF THE EXTENDED PLATFORM TO BINS BELOW, ADJACENT TO THE CORE ROOM—NOTE THE ELECTRICALLY HEATED CORE OVEN AT THE RIGHT

Engineers Show Building Construction Features

Mills, Rhines, Bellman & Nordhoff, Toledo, O., engineers of industrial plants, have published an unusually attractive book describing and illustrating various buildings constructed under their direction. The plants described include automobile factories, brass foundries, machine shops, paint factories, iron foundries, plow works, forge shops and miscellaneous manufacturing establishments. Some modest establishments representing the average run of industrial construction are given equal prominence with some of the most extensive factory establishments comprising groups of industrial buildings.

Cost Data Essential to Foundries

Costs Form Basis of Selling Price—Accountant Should Be Able to Analyze Costs and Furnish Reports Which the Executive Can Understand and Apply Readily to Production and Sales

BY ROBERT E. BELT

TO FOUNDRYMEN, the subject of costs has not the same general interest as have other subjects which seemingly are more closely related to production or to profits. However, the question of what it costs or will cost to produce a particular type of casting, and at what price it can be sold, is more closely related to the objects of conducting a business, namely profits, than any other subject to which the foundryman is required to give consideration. The effect of costs on the profit and loss statement is a most direct one as a distorted relation between costs and selling prices produces a serious situation. The longer the executive is in ignorance of a disturbed relation between costs and selling values, the more serious the situation becomes.

Accurate cost information is undeniably the only true basis upon which to make prices, and arbitrarily quoting a price irrespective of the actual or of the normal cost of production almost invariably produces bad results, both to the individual company and to the industry as a whole. The foundryman's most dangerous competitor, and the industry's greatest menace, is the fellow who is selling his product without a knowledge of its cost of production. It is obvious that one should know the cost to produce each kind of work he manufactures, as competitive conditions are seriously disturbed where losses on one or more kinds of work are recovered from profits on other kinds of work.

Practically all foundrymen recognize the importance of accurate and dependable technical information in the management of their plant; of determining the constituents and properties of their iron, and of melting under laboratory control; of the advantages of paying labor on the piece-rate basis; of the advantages of machine molding over hand molding; and the importance of modern methods of handling and conveying materials. While foundrymen admit advantages are found in the more modern technical and physical methods, they are extremely slow to admit there are equal advantages to be derived from modern office methods—methods by which the operating efficiency of the foundry can be watched and by which true costs of the product can be determined. No matter how modern and improved may be the technical end of the business, its successful conduct is not assured unless the cost of the various classes of product is known and the product disposed of at a figure in excess of cost. The successful conduct of any business depends upon selling the product at a profit, and to be certain one is selling at a profit the accurate cost of what he is selling must be known.

Determining Selling Price

Experience has demonstrated that in the production of castings it is not safe to base a selling price on an average cost. In a jobbing foundry, the cost of the work of no two customers is the same; the cost of no two patterns of castings is the same. Conditions vary with almost every order, and the cost of produciton always varies with the conditions. The variations in cost should be known, studied, analyzed and watched.

Whether the product is gray iron, malleable iron or steel castings the most satisfactory cost in a jobbing foundry is a cost on each principal pattern of castings. The first impression is that to get a quarterly or a monthly cost on each principal, or long running pattern of casting, would involve an immense amount of clerical work. Experience proves that is not the case, particularly where the cost system is free from complications and from hair-splitting refinements. The manufacture of castings is not a complicated process and I have never been able to see why the accounting need be more complicated than the manufacturing process itself.

Next best to a cost on each principal pattern of casting is a class cost, the castings being classified by weight per piece divided into plain and cored classifications. For gray-iron foundries engaged on light work of not extremely dissimilar types the weight classification for costing purposes usually gives fairly good results.

Adequate costs, apart from their value for price making purposes, are an index of operating efficiency. With properly prepared costs, the relative efficiency of the different departments of a foundry can be watched and compared. The current results obtained in each department can be checked against those obtained in the past, thereby showing increases in efficiency, or the reverse, and the results of improvements in plant practice. Complete and properly designed cost statistics will be found to exercise the important function of lowering costs and holding them at the lowest possible level.

Foundrymen who have not installed cost systems ordinarily have a number of reasons for not doing so. One of the objections is the feeling that exists in the minds of many that their particular business is so different from others that no system which could be operated in a practical manner would give them dependable results. It is true that some lines of foundry production and foundry practice lend themselves more readily to the determination of costs than others, but it is also true that no line is so complicated or the plant organization so complex but that a workable system can be devised and operated in a thoroughly practicable manner which will give reasonably accurate results.

The most common objection is that of the expense of operation. Many foundrymen are of the opinion that a cost system means an interminable amount of detail and red tape and the employment of a number of additional clerks. It is true that some extra labor may be required, but not to the extent that most foundrymen believe.

The foundryman who is fortified with an accurate knowledge of his costs of production always has an advantage. Every foundryman should know his costs, regardless of cost methods. However, it is far better if each distinct branch of the industry were to adopt uniform methods, as unfortunately, differences in accounting methods do produce different results.

The maximum economies in the production of castings are largely the result of a study of comparative costs of production, thus enabling the management to maintain a standard of

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efficiency in keeping with the more efficient results. The most conclusive proof of the value of accounting from an operating standpoint is the fact that one of the first moves made by a large corporation, or holding company, operating a number of plants manufacturing a given product, upon acquiring an additional plant, is to change over the accounting system to the uniform one in use at the other plants of the company. No large corporation today attempts to conduct its business with nonuniform methods of accounting, or in other words, without a comparison of costs at the different plants. It is imperative that a comparison be had as only in this way can the relative efficiency of the different plants be determined. If operating inefficiency is disclosed in this way in a large corporation operating various plants, should not the same be true in an entire industry, or in a distinct branch of an industry, through the use of similar methods?

Competition Should Be Fair

The advantages to an industry of uniform accounting methods from the standpoint of unfair competition are of equal importance. There is a form of competition to which a foundryman cannot object, even though it cannot be met, and that is the competition of the man who prices his work on the basis of cost and whose lower price reflects advantages by reason of efficient methods of production. However, the competition to which objection can be rightfully raised is that of the man, who, having no dependable knowledge of his costs sets prices which preclude the possibility of there being an adequate profit in the business for anyone. It is this situation that a knowledge of costs largely corrects for rarely does a man price a product at less than cost when he knows its costs, but if he does not know its costs the price unknowingly may be less than cost. Therefore, uniform accounting, which recognizes the fundamental principles applicable to cost finding in the particular industry, has the effect of reducing unfair and unintelligent competition, but uniform accounting in itself does not regulate prices and does not in any measure restrict competition.

The adoption of uniform accounting methods, does not mean uniform costs. There is and always will be differences in costs of production. It is natural and right that there should be differences in costs, but such differences as do exist should represent actual conditions resulting from better plant organization, higher efficiency, more favorable location, and other operating factors. In the industries, where uniform cost methods are recognized and followed, the members know that differences in costs are due to operating factors, as their costs are built up in a like manner and include like elements of cost. In competition the companies can feel that they are competing on an equal basis and have the satisfaction of knowing that they will not be called upon to meet a price that has been based upon widely different costs determined in an entirely different manner.

The conditions that were found to exist in one of the branches of the foundry industry prior to an effort to improve and standardize cost methods are typical of conditions in other branches where no special cost education efforts have been made. About three years ago, in the branch of the foundry industry referred to, a test was made of the competitive conditions which resulted where concerns were either using different accounting methods or guessing at their costs. Two castings each were furnished 43 different foundries which were asked to quote on an inquiry for 10,000 pieces of each pattern and to give their total estimated cost of production on the basis of $40.00 iron, delivered. With the actual castings before them and the price of iron fixed, you would not expect any great variation in estimated cost; but here is the result of the inquiry: Of the 43 cost estimates, on the one casting, about one-half showed a fairly narrow range—from about 7¼ to 8¼ cents per pound. Those were the foundries that were in a position to prepare an estimate on some more or less accurate basis. The variation in the estimated costs of these particular 20 odd foundries did not cause any special concern. It was the other half of the concerns, barring a few unreasonably high estimates, which were the ones that were crippling the industry through the establishment of a price which precluded anyone from getting business at a living price.

Hit-or-Miss Prices

As compared with a normal and fair cost at that time (on the basis of $40.00 iron) of about 8 cents per pound, there was one estimated cost of a fraction less than 5 cents; another at 5½ cents; and six others under 6½ cents. Excluding one abnormally high estimate, the range of the 43 cost estimates was from 4.9 cents per pound to 11.6 cents per pound.

The cost estimates on the other casting, a more costly one to produce on account of its lower output per molder per day, were still considerably wider. Here again, the estimates of the companies which had dependable records upon which to base their estimates did not vary widely. They were from 12½ to 14 cents a pound. Compared to these normal estimates, there was one of 8.3 cents and another of 8.6 cents. Of the 43 foundries estimating on this particular casting (all using $40.00 iron as a base) there were two estimates over 20 cents per pound, and six estimates under 10 cents per pound.

Produce Without Profit

With conditions such as these existing, is it any wonder that the foundry industry is a hazardous one and that a good proportion of the aggregate tonnage, under normal conditions, is produced without profit? Is it any wonder that there is so much dissatisfaction among customers when they learn that others in their line are securing their requirements of similar castings from a trust-to-luck foundry at prices 50 per cent less than they are paying? There probably is not another industry where there is so much *shopping around* for prices as there is in the foundry industry. This is the direct result of a knowledge on the part of buyers that many foundries do not know their costs and that probably the buyer will be able to get his requirements from these shorter-sighted ones who just naturally know their costs, and who manage to exist for a time at least by selling without profit.

The investigation referred to, apart from disclosing the futility of meeting prices which were made without a realization of the actual costs of production, revealed the fact that there was almost as much variation in the estimated cost of molding as in the estimated overhead; that there was as wide a range in the price that the molder would be paid per mold for molding as there was in the total estimated cost. In the same locality, where practically the same labor rates prevailed, the molder's price per mold for the same sized flask would vary as much as four cents, or the equivalent of $20.00 per ton in the final cost of the casting.

A study of this important cause of variations in costs as among different plants disclosed that piece prices in most foundries—the foundation of costs—were determined by rule-of-thumb methods, and that there was no common basis upon which different plants could determine an equitable piece price for molding a given type of casting. Therefore an effort was made to determine piece prices for molding in a

somewhat scientific manner along basic lines, or standards which would be of general application.

For bench or squeezer molding, as an example, it was found that the molding price per mold could be based on a series of well defined operations or factors, such as the cubical contents of the flasks, the number of cores and chills to be set, the handling of the pattern and flask etc. These, in the main, constituted common factors and a standard value was placed upon each, such as a factor of 30 for each 1000 cubic inches of flask content up to 2000 cubic inches; a factor of 50 for each 1000 cubic inches in excess of 2000; a factor of 2 for each small core set; 3 for each moderate size core set; 4 for each large core, and 8 for each complex core; a factor of 12 for handling a plate pattern of 1 gate; a factor of 2 for each additional gate, etc. The sum of all the factors expressed in cents represented the relative value of the particular job. To reduce the sum of the factors to a price reflecting the prevailing wage scale of the locality, all that was required was to multiply by a coefficient which would produce the average desired earnings per hour.

Molding a Prime Factor

The above plan is in successful operation by a large group of foundrymen and it is assisting materially in the standardization of plant practices and in the elimination of artificial differences in costs. It is only another effort for the establishment of equitable earnings of employes and for maximum reduction of guess work in one of the chief elements in the cost of a finished casting.

The principal reason, I think, that cost information has not attained the position in the foundry industry that it rightfully should occupy is the belief of the average foundryman that any kind of help is good enough for the office; that an office boy in a year or two is fully equipped to take charge of the company's cost work. This is a serious mistake, particularly as most foundry executives have neither the time nor the inclination to analyze costs in order to determine the conditions which resulted in an unusually high or an abnormally low cost. This is the work of the accountant for the assistance and enlightenment of the executive and it is not the work of the executive. It is this phase of cost accounting in which the so-called accountant is so often deficient and, as a result, unless the executive realizes the accountant's deficiency he is most likely to decide that costs are of little value and that the work of the accountant is unproductive.

The shortcoming, primarily, is the accountant's, and secondarily, the executive's. The cost accountant who neglects the proper application of his work and who is not inclined to read and analyze and present his findings, is not filling his mission, and the executive who condones the omission of that essential in the accountant either never has been awakened to the possibilities of accurate and complete business information or is deficient as an executive.

Many foundry executives manifest but little interest in cost results and when the accountant is of the same trend of mind, it is not surprising to find a feeling which is adverse to cost work. However, this latent faculty of the executive is easily and quickly exercised when the accountant presents the results of his work in a manner which means something to the executive. When the executive sees that accurate and complete cost information results in the reduction of expenses or in an increase in selling prices, he is going to realize the importance of the work.

The writer well recalls one executive, the president and general manager of a large foundry, who until recently had always looked upon the expenses of his small cost department as a necessary evil, but who has completely changed his conception of costs and their value through the employment of a chief accountant who has a realization of the purpose of costs and who presents his information and results of his findings to the executive in a clear and convincing manner. Today this executive looks forward to the monthly statement of costs with more concern than to any other statement which passes over his desk. He sees where the current cost reports mean and have meant to greater profits, and today when the management of this foundry wants to know the effect on costs of the acquisition of new equipment or of the installation of a molding machine for a particular job, it is the accountant from whom data and an opinion are requested and it is largely his findings which determine the action of the executive.

The question of what the foundry cost accountant can or should do to reap the most benefits from his labors and thus to be of the greatest service to his employer is one somewhat difficult to answer, as conditions vary. Generally speaking the work of the accountant should at least cover two fields, namely, ascertaining costs, and presenting them in an analytical and comprehensive manner. These are the accountant's essential duties.

The department of the foundry management for which an analysis is made will largely determine the nature and character of the accountant's report. Generally, an analysis and report should be made for the operating or manufacturing executive, for the sales executive, and for the general administrative executive.

The operating executive of a foundry should be furnished with current comparative unit costs in sufficient detail to clearly illustrate the factors influencing cost fluctuations. Departmental labor costs comprise the most fruitful source of statistical and analytical information which can be furnished the plant management. Unit labor costs of the several departments can be readily shown so that the operating executive can easily see exactly from them where the labor costs were abnormal. They should be presented in comparative form, showing increases or decreases in cost per unit of product, and it is well to chart the cost trend for a period of months. In addition to presenting comparative costs of labor per unit of product by departments, it is well also to show comparative earnings of employes per hour, arranged by departments and by classes of labor. Various other statistical and analytical data can be profitably prepared for the operating officer, such as the average production per molder per hour, classified by types of product and methods of molding; the average weight per piece of castings produced; an analysis of the gross metal charge showing the loss of metal from oxidation; the percentage of bad production; the percentage of good production; the consumption of fuel, sand, firebrick and other materials per unit of output. Other statements of equal value will suggest themselves to the alert accountant.

Sales Department Need Varies

The character of the information which the sales department needs differs materially from that required by the manufacturing department. The primary interest of the sales department in costs is in connection with the establishment of selling prices, and therefore, total costs of production of individual patterns of castings or classes of castings covering past and future periods are of the most concern. In fact, the interest of the sales executive should be in what the costs will be for the immediate future, and it is here that the accountant has a real opportunity to use his knowledge

and experience in forecasting costs. However, his forecasts should always be based on the actual costs for the most recent period, modified by existing current conditions. He will have to take into consideration many factors of which may be mentioned variations in output, in material costs, in labor costs, in overhead, etc., but with the accountant's first-hand information and with his knowledge of causes and effects, he is in a position to forecast costs with accuracy.

In most foundries of the smaller size, both sales administration and general administration are under the direction of the same official. When this is the case, the analytical reports to be submitted would not differ from those which would be prepared for the sales executive, but in addition, they should embrace a summary monthly profit and loss statement, arranged to show the month's shipments, the cost of the shipments, with beginning and closing inventories of raw materials, work-in-process and finished castings, and the month's profits. The statement should show both aggregate values and unit values. The unit values and profits for the month should be presented in comparative form, month by month and cumulative.

Needless to say, statements should be standardized and the accountant should prepare them regularly and promptly and have them reach the executive's desk with unvarying promptness. The executive will then learn to expect them and even though the statements at first may not receive the consideration they deserve, it will not be long until they will be awaited with keen concern and will play a most important part in the administration of the business.

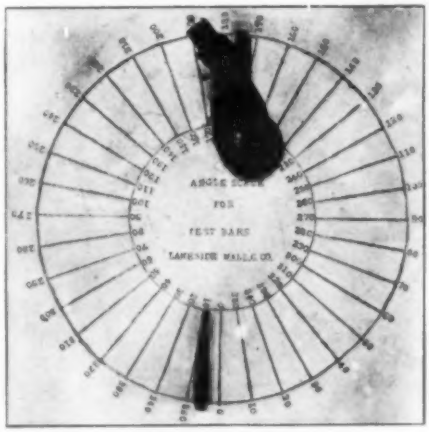
Establish Sales Offices in the Orient

Lionel R. Vinall Moon, managing director of the Associated Machinery Corp., Chicago, has arrived in Burma where he will open offices. After spending a few weeks there he will proceed to India and Ceylon to open other offices. The Associated Machinery Corp. recently was formed to introduce to India, Burma and Ceylon the latest in construction equipment. The following companies are incorporators: Pawling & Harnischfeger Co., Milwaukee; Novo Engine Co., Lansing, Mich.; Insley Mfg. Co., Indianapolis; Blaw-Knox Co., Pittsburgh; Chain Belt Co., Milwaukee.

New York offices of the corporation are located at 50 Church street, under direction of C. L. Langlotz.

Suggests New Method for Reading Bend Tests

To The Editor:—While the idea of the bending test published on page 897 of the Nov. 15 issue of THE FOUNDRY is good, the method given for reading the dial cannot give accurate readings. In Fig. 5, for instance, it is self-evident without the use of a dial that the bar has been bent through an arc of considerably more than three right angles, yet the reading taken from the dial is only 265 degrees, or less than three right angles. It is also evident from the illustration that by the method given the readings would vary with the diameter of the graduated circle. For instance, in Fig. 5, if the test bar were turned around to point the other way and the reading taken on the smaller circle it would



DIFFICULTY OF READING THE ANGLE OF DEFLECTION IS SHOWN BY THIS BAR

show 250 degrees, which is even farther from the correct value.

Correct values will be obtained if the reading is taken from that line which is parallel to the grip of the test bar. Thus, in Fig. 5 the correct reading is 290 degrees and in Fig. 4 it is 200 degrees.

ROBERT F. WOOD,
Metallurgist, Monel Metal Products Corp., Bayonne, N. J.

To The Editor—I appreciate Mr. Wood's comment. He is correct in stating that a more accurate figure can be obtained by reading the angle of the line parallel to the end of the test bar. However, many factors affect the accuracy of the test, and for the relative bendability of a series of test bars, our method of reading is quick and the results by our method of reading do not differ greatly from those obtained from the method suggested by Mr. Wood. To show the difficulty of getting absolutely accurate figures I enclose a photograph of a bar which bent 545 degrees by our method, or about 580 degrees by Mr. Wood's method. All things considered, it seems that Mr. Wood's method of reading is the more accurate, and we thank him for his suggestion.

EDWIN K. SMITH,
Metallurgist, Lakeside Malleable Castings Co., Racine, Wis.

Book Review

Protection Our Proper Permanent Policy, by James T. McCleary; 544 pages, 6½ x 9¼ inches; cloth; published by The National Tariff Institute, Inc., Washington and St. Paul, and for sale by THE FOUNDRY, Cleveland, $3.50 postpaid.

This work has a peculiar interest to the iron and steel industry because of the wide acquaintance of the author in that field due to his having served for a number of years as secretary of the American Iron & Steel institute. In his preface Mr. McCleary says that the book has been written in faith. He makes clear by his elaborate exposition of the principles and beneficent accomplishments of the American protective tariff that his faith in protection as a national policy is strong and uncompromising. The author proves himself truly to be a deep student and a zealous advocate of national progress through the tariff. Probably no better equipped author from long experience and favored observation could have undertaken the task of presenting the doctrines of the pure and unadulterated protection of past years in these days of modified faith amid changing world conditions. He has brought to his task the fruits of study and of participation in tariff making which have come to him from a long and illustrious public career. Mr. McCleary served in congress from the second Minnesota district for a period of 14 years and was active in the councils and deliberations of his party. Under President Roosevelt he filled the office of assistant postmaster general.

The book lays down the fundamental aspects of the tariff question, analyzes the experiences of foreign countries, traces the history and operations of the respective American laws and also the development of the American protective system, winding up with a discussion of scientific tariff revision. As a supplementary and closing feature to his volume, the author presents a part entitled "Fair and Friendly Relations Between Capital and Labor" which is introduced with a chapter entitled "A Square Deal for All." In this section are interspersed various quotations from editorials, articles, public addresses, etc. dealing with various phases of the relationship of employer and employes.

Machining Qualities Set Standard for Telephone Box

BY H. R. SIMONDS

WHEN central answers to the click of a nickel in a pay station telephone and returns the nickel if the line is busy, the process involved is accepted with little question, and few who use these pay stations give any thought to what is inside of the box or how the device was made. A man at Hartford, Conn., named George Long, now manager of the Gray Telephone Pay Station Co., largely is responsible for the design and method of construction which has made the automatic pay station telephone a commercial possibility today.

The foundation of the box which forms the upper portion of the instrument shown at the top of the page is a gray iron casting of exceptional smoothness and uniformity. This casting is better shown in Fig. 7. In producing the completed instrument this particular casting has 57 holes bored into it. Originally, these holes were bored on modern high-speed drill presses with guiding fixtures, and the speed even on strictly repetition work was 58 castings per man per day. With the desire to increase the production, Mr. Long developed the automatic machine shown in Fig. 1. This machine was built at the Gray Telephone Pay Station Co.'s plant specifically for this work. It contains five movable heads which operate simultaneously, closing in on the casting and drilling all 57 holes at one time. Two of the heads have drills operating in two directions at the same time, thus giving the effect of seven independent operating heads. The casting is placed in the center in a jig as shown. Because of the varying diameters of the holes and also the varying depths of cut, it is necessary to have each spindle revolve at the proper speed for its particular work. The drilling is entirely automatic, the operator merely fastening the casting in the jig and removing it when completed. The operation, including picking up the casting, placing it on the machine, removing it after the drilling has been completed and piling it on the stack, takes about 1½ minutes. The illustration clearly shows the method of operation. The castings ready for drilling are brought piled on skids, which are transported by lift trucks. Similar skids are placed near the operator to receive the drilled castings.

After developing this machine and overcoming the drilling problem, a difficulty was encountered through lack of uniformity in the box castings,

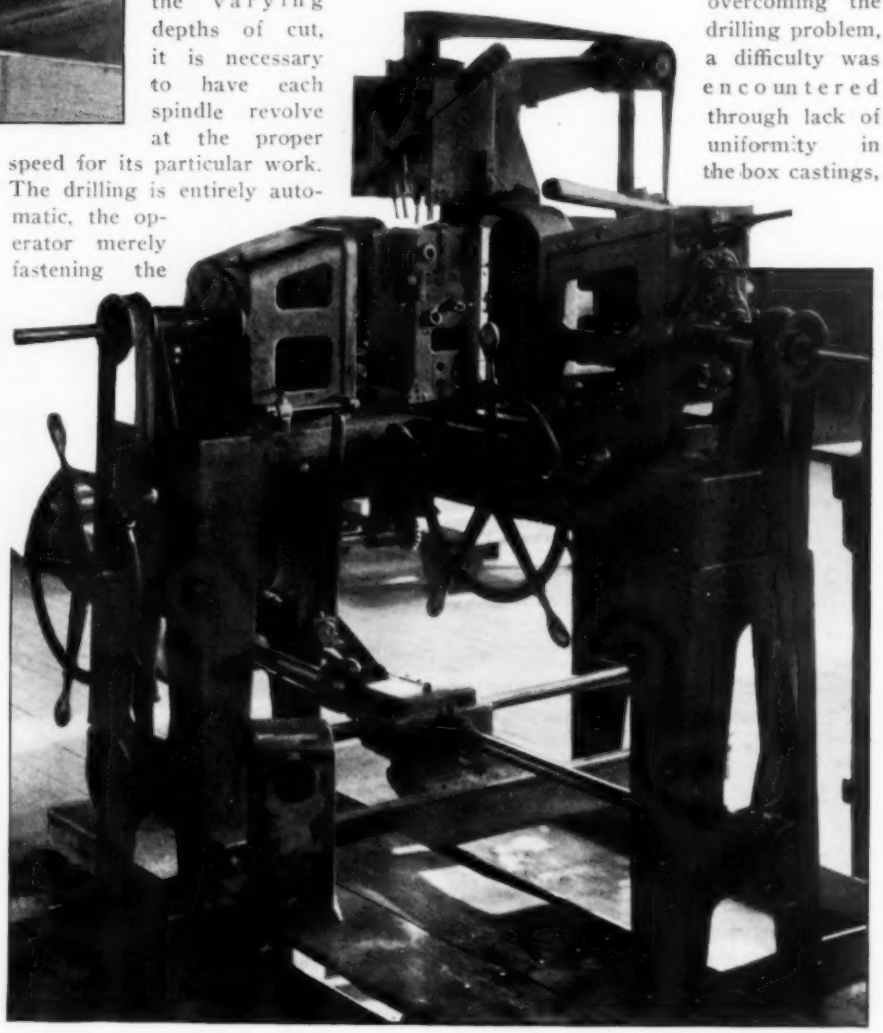


FIG. 1—THE CASTING WHICH FORMS THE UPPER PORTION OF THE TELEPHONE BOX HAS 57 HOLES DRILLED IN IT SIMULTANEOUSLY BY THIS AUTOMATIC MACHINE WHICH HAS FIVE MOVABLE HEADS AND DRILLS ENTERING IN SEVEN DIRECTIONS

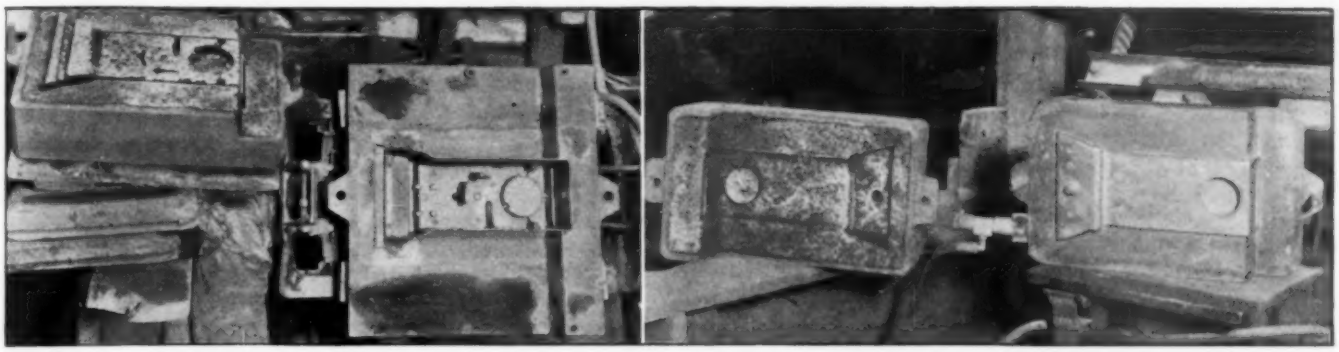


FIG. 2—AT THE RIGHT IS THE PLATE USED TO FORM THE DRAG, AND AT THE LEFT IS SHOWN THE DRAG JUST AFTER IT HAS BEEN MOLDED—FIG. 3—AT THE RIGHT IS THE PLATE USED IN MOLDING THE COPE AND AT THE LEFT IS SHOWN THE COPE WITH GATE

which meant broken drills. Naturally as the operation is automatic, the adjustment of the drills, must be fixed which means that a small drill must operate just as fast if a hard portion of the casting is encountered as it will if the castings are soft. To overcome this varying hardness was the problem for the foundrymen, and as the Gray Telephone Pay Station Co. does not operate a foundry, the question was presented to several high grade foundries in the Hartford district.

Several of these foundries have enviable reputations for turning out uniform and flawless castings, and two or three after some study and experimenting, have been able to produce a box frame which meets all of the requirements for this pay station instrument construction. One of the foundries which is successfully making these castings in quantity is the Foster-Merriam & Co., at Meriden, Conn. This firm was started in 1835, and its foundry gradually was enlarged until last year, when it was 85 years old, it was completely rebuilt to give double its former capacity. At present the foundry has 55,000 square feet of molding space, and employs 80 molders. The building is high and well ventilated, with steam heat for winter, with washroom and locker rooms, and core rooms for men and for women coremakers located separately from the foundry proper. Equipment includes squeezers, rollover jolts, jolt strippers and jolt squeezers and over 80 per cent of the output is produced on molding machines. The foundry is essentially a quality shop and is reluctant to take work which does not require care in its construction. Iron is melted in two cupolas, one made by the J. W. Paxson, Philadelphia, and the other by the Whiting Corp. Harvey, Ill. Metal is transported to any point in the foundry on an overhead trolley system.

FIG. 4—THE CASTING JUST AS IT IS TAKEN FROM THE MOLD—THE LOCATION OF THE KNIFE GATE IS INDICATED

The total melt of this shop normally averages about 40 tons, and slagging of the cupola is said to be unnecessary. The general foundry practice will be better understood by fol-

FIG. 5—THE FLOOR SECTION USED FOR MAKING THE TELEPHONE CASTINGS IS BY ITSELF AND LOCATED NEAR THE CUPOLAS SO THAT IRON IS NOT COOLED IN CARRYING

lowing through the operations in connection with the casting under discussion.

The telephone box is made on plates, as shown in Figs. 2 and 3, which are mounted on rollover draw machines. The design of the piece makes it advisable to separate the flask on an uneven line rather than to follow the usual practice of straight line division. This means that specially built flasks are required. These are clearly shown in Fig. 5, which shows a portion of the foundry given over exclusively to this work.

With the plate in position, the molder takes the corresponding part of the flask and locks it in place on the plate. He then sprinkles on a coating of special fine parting dust, then sifts on about two inches of sand. In this particular case the sand is a mixture of No. 0 and No. 00 Albany molding sand. The drag portion of the mold contains so many projecting lugs and thin webs that great care is necessary in ramming the sand. It has been found necessary to do this part of the work by hand and unless the bases of the projections are carefully packed, the pressure of the squeezer, however strong, will not remedy any open space or cracks. After the first layer of sand has been hand rammed, the drag is filled and then squeezed. Afterwards it is vibrated and carefully drawn. Fig. 2 shows the drag after it has been taken from the plate.

The drags and copes are made on machines located adjacent to each other, so that the molds are completed on the foundry floor as the work progresses. The cope in this particular case is much simpler and is made on an automatic molding machine.

In pouring, exceptional care is taken to have the iron as hot as possible, so it will flow freely into all of the small sections. The method of gating is shown in Fig. 4. The double knife gate extends across the full length of the opposite sides of the casting at the top as it is cast, but at the bottom as it stands in place on the telephone. The casting after cleaning weighs approximately 7½ pounds. Its walls are uniformly ⅛-inch thick, with some projections as thin as 1/16. The outside dimensions are 5 x 4¼ x 11 inches.

Molding the drag takes about one minute and 50 seconds and of the cope, approximately 50 seconds. Molders work steadily until the cupolas are tapped, when they pour off their day's production. After this a night gang takes charge of each floor. The telephone box castings are left in the molds until sufficiently cold to avoid warping. Molds are then dumped and the sprues broken off from the castings, which are then taken to their proper places in the cleaning department. The sand which remains is wet down, cut; cooled, tempered and piled ready for the next day.

FIG. 6—AFTER A PRELIMINARY CLEANING, CASTINGS GO TO THE TESTING ROOM WHERE THE MOST MINUTE DEFECTS CAUSE REJECTION FIG. 7—CLEANING BOX—THE CASTING WHICH IS SAID TO BE ONE OF THE MOST DIFFICULT SMALL CASTINGS EVER TURNED OUT IN CONNECTICUT

A complete record of each man's work is kept each day. This is done by a system which is somewhat unusual. Each plate has a number and date which are impressed upon the castings. The date is changed every week, so that at any time all castings may be traced back to the molder. All castings turned out by an individual molder carry the same number, and these are placed in barrels or containers and kept separate until they pass the inspector. The molder's pay is based on the number of castings passing inspection. After the first inspection, which is shown in Fig. 6, the castings go to the sand blast room, a corner of which is shown in Fig. 7. After sand blasting they pass a final inspection and then are loaded on trucks and transported 20 miles to the door of the Gray Telephone Pay Station Co. plant.

The uniform quality of these castings is obtained:

First: By watching carefully the analysis of the cupola run. Tests are taken each day and sent to commercial chemists who report by telegraph the result so that the metallurgist is guided in his work on the following day. The average analysis for the castings described is as follows: Silicon, 2.83 per cent; sulphur, 0.085 per cent; manganese, 0.52 per cent; phosphorus 0.54 per cent.

Second: By keeping the iron as hot as possible until the time of pouring. This is done by preheating ladles and by having the floor section located as close to the cupola as possible.

Third: By carefully pouring and using a relatively heavy riser.

One feature which helps in securing uniformly good results is the loyalty of employes, the majority of which have been with the company for many years. Fathers and sons and relatives are all represented among the molders, and generally speaking each molder takes pride not only in his own work, but in all the work of the company.

Add Ferroalloys to Steel in Thin Stream

DEFECTS in castings sometimes are traced to the ladle additions not being evenly distributed through the metal or not performing their function properly. Occasionally defects which cannot be traced to their true origin are attributed to the way the ferroalloys have been added. This question of the proper way to make ferromanganese or ferrosilicon additions is decided in various ways. Sometimes the manganese is added hot, but more frequently it is thrown into the ladle cold. Some foundries add it in the furnace but this method requires more of the ferromanganese than when the alloy is added to the ladle and is not generally used although a more uniform distribution of the metal is thought to be secured by this process. A thorough and uniform distribution is essential to secure homogeneous steel. When the ferroalloys are thrown into the ladle by the shovelfull as the metal runs from the furnace, the cold material sometimes is heated so it welds together before dissolving and forms a lump that is difficult to melt and distribute through the metal before the entire mass solidifies.

To overcome any tendency for the ferro additions to go into the metal in a large bulk the Ohio Steel Foundry Co., Lima, O., has installed the special rig, shown over the furnace spout in Fig. 1. This consists of a box made of steel plate and fitted with a small gate in the front. The gate is controlled by a long lever which may be seen extending along the side of the furnace. In operating the lever, the workman stands well away from the heat of the metal and is not subjected to discomfort. After enough steel to fill the ladle to a depth of several inches has run from the furnace, the workman pulls the lever and allows the ferroalloys to fall in a thin stream into the metal from the furnace.

The ferroalloys as they are received are in large pieces. These are too bulky to add directly to the steel, so they are broken in a jaw crusher. The crusher has two jaws which form a V-shaped opening. The one jaw is stationary and the other swings on a pivot, propelled by an electric motor belted to the machine. In swinging, the movable jaw moves alternately toward and away from the stationary jaw thus enlarging and contracting the V-shaped opening. This crushes the alloys to a varying size from a powder to walnut size. No separation or grading is made in material as it comes from the crusher, before it is used.

Resigns Position

H. F. Hoevel has resigned his position as secretary and general manager of the Hoevel Mfg. Corp., Jersey City, N. J. At present he is located at the Chemists' club, 52 East Forty-first street, New York City.

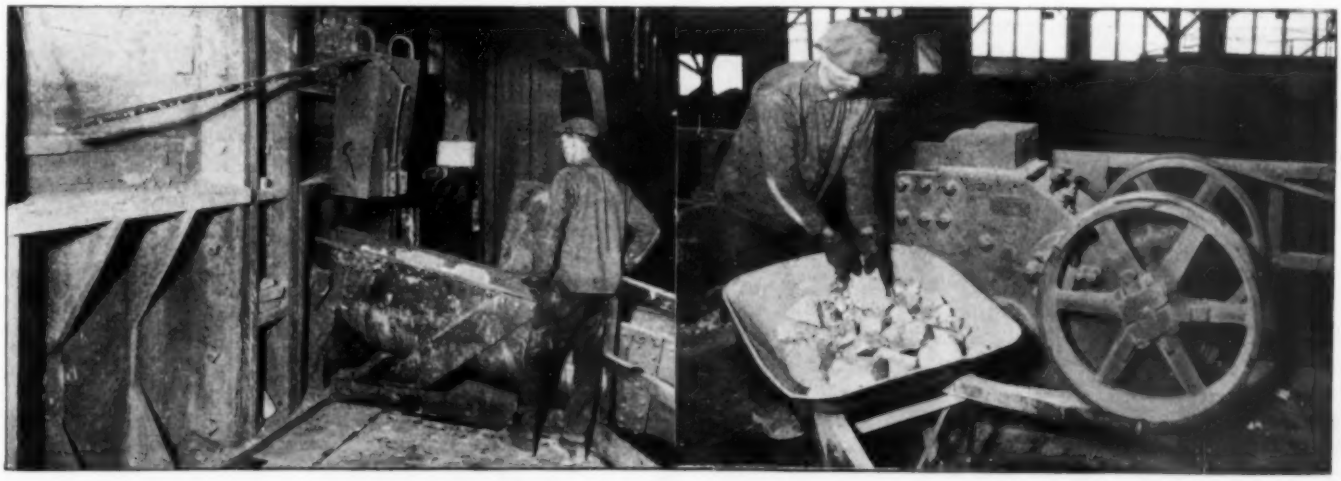


FIG. 1—THE ALLOY IS PLACED IN THE BOX ABOVE THE POURING SPOUT AND RELEASED WITH THE LEVER SHOWN TO THE LEFT FIG. 2—FERROALLOYS ARE RECEIVED IN LARGE LUMPS AND BROKEN TO WALNUT SIZE OR SMALLER IN A JAW CRUSHER

How and Why in Brass Founding

By Charles Vickers

Brass Balls Are Porous

We are making brass sleeves and balls, and are having trouble due to the castings being porous. When poured the metal oozes back out of the gate and risers. We are trying for a mixture of copper, 85 per cent; tin, 10 per cent; zinc 5 per cent, and we add a small piece of phosphor copper. The sleeves weigh about 450 pounds. We dry the molds, and cast them on end with two gates; one gate one-third the distance and the other gate two-thirds the distance down.

The balls we are casting in green sand on the side, they weigh from 150 to 250 pounds each. We shall be pleased to have your suggestions.

The castings are used for bearings and the alloy given is a poor bearing metal. An improvement would be to change the zinc to lead, and to use about ¼ per cent phosphor copper. The metal largely is to be blamed for the trouble as it backs out of the heads, showing that it is aerated. Melt the copper under charcoal, and put some phosphorized metal from a previous heat in the bottom of each pot when starting to melt. Make the cores of sharp sand and have a circle of heavy vents not more than an inch away from the metal sides of the core, and have the core bone dry. Be careful not to pour the metal when it looks dull to the eye, as then it will carry oxides into the mold. The ball sleeve should have the heavy section fed solid by a heavy riser.

Melting Brass in Cupolas

We are planning to make a number of brass covers which will weigh 1000 pounds each, and our brass furnaces will not melt this amount of metal. Therefore, it will be necessary to use our No. 3½ cupola. This is lined down to 28 inches. It is our intention to melt heavy brass scrap, such as globe valves and brass flanges. Would you advise us to try this in our cupola?

While the cupola is not a melting medium that can be recommended for regular service in melting nonferrous alloys, it occasionally is used with success. The reason why a cupola is not suitable for such alloys, of course, is the fact that the fuel and the metal come together. Also, the more volatile metals in the alloy, such as zinc, are burned out.

In this case prepare the bed as for iron; but before charging the brass, put a layer of charcoal on the coke. As the brass melts more easily than cast iron, the bed can be thinner. To restore the zinc burned out and to deoxidize the alloy; melt in the crucible furnaces an alloy as follows:

DEOXIDIZING ALLOY

Metal	Per cent
Copper	68.00
Zinc	30.00
15% phosphor copper	2.00

Figure the contents of the ladle into which the bronze will be tapped. Allow 6 pounds of molten deoxidizing alloy for each 100 pounds of bronze in the ladle. Pour the deoxidizing alloy into the bronze tapped from the cupola, keeping a cover of 2 inches of charcoal on the surface of the metal in the ladle. After the addition of the alloy, thoroughly stir the contents in the ladle if means can be arranged.

Specifications for an Alloy of Aluminum

We have received an order for aluminum castings of the following specifications which give the limits of the constituents, and we desire to know what are the best proportions. The specifications follow: Copper, 6 per cent, maximum; iron 0.5 per cent maximum; silicon, 0.5 per cent, maximum; manganese 3.0 per cent, maximum, and aluminum 94 per cent minimum.

As iron and silicon always are found in commercial aluminum, the limits are placed sufficiently high to allow any good grade of aluminum ingot to be used. Therefore, these two constituents should be eliminated from consideration as a part of the desired alloy, as they both will be found by analysis. As the tensile strength demanded is 18,000 pounds per square inch, with an elongation of 15 per cent, the copper is much too high to get these results, at least the elongation. Therefore, the copper should be diminished, how much a few tests will show. The same remarks apply to the manganese, this also is put at the maximum, and it is double the amount necessary. A specification of 15 per cent elongation is too high for this formula, in the case of sand-cast test bars, and an elongation of 8 per cent would be nearer the possibilities. As high as 20 per cent elongation has been obtained with 20,000 tensile strength in the case of sand-cast test bars for aluminum alloy; but this formula is entirely different, and is held strictly secret. We suggest this specification for elongation of 15 per cent be changed, for it cannot be obtained consistently with an alloy of aluminum, copper and manganese. The castings must be gated from the bottom, as the alloy is *thick*. Heavy sections must be chilled, and sullage heads placed on of heavy section.

Lead Sweats from Alloy

We have experienced trouble with acid-resisting castings and wish you would give us some advice. We have used two mixtures; one with 85 per cent copper and 15 per cent lead; the other with 90 per cent copper, 10 per cent lead and 1 per cent tin. We have been melting the copper and putting the lead in just before pouring, but the leads sweats.

We should imagine that both these alloys would be so soft they would be almost worthless even if properly made. However, if for any reason one of these formulas is desired, the lead can be held in solution with the copper when the metal has cooled by the use of a flux.

FLUX FOR LEADED ALLOYS

	Parts
Sulphate of Soda ($NA_2 SO_4$)	20
Plaster of Paris	20
Salt (common NA Cl)	20
Borax	15

Use 2 pounds per hundred pounds of metal, put the flux in the crucible with the copper and melt. As much as 50 per cent lead has been *held* by flux. The following alloy is better:

CHEAP ACID RESISTING METAL

	Pounds
Copper	76
Lead	18
Tin	3
Nickel	3

Melt the nickel and the copper together with 2 ounces of phosphor copper in the bottom of the crucible, then add the tin and the lead, and if the lead causes trouble use a little of the flux given.

Seeks Better Acid-Resisting Alloys

Requirements Analyzed and Details of Tests Given—Casting Conditions Affect Results—Samples Tested in Mine Water Show Greater Loss Than Those Tested in Sulphuric Acid

BY GEORGE A. DRYSDALE

FOR many years a great demand for true acid resisting metals has existed, more especially in the chemical and coal mining industries. In fact, it has become one of the great metallurgical problems of the day and up to the present time no metal or alloy giving satisfactory results, in a broad sense of the term, has been attained. It is true that much thought is being given and experimental work carried on by large manufacturing corporations, to solve this problem. Also, the United States bureau of mines at Pittsburgh is conducting a series of tests on the various known metals and alloys, to determine their acid-resisting properties.

In the use of ferrous or nonferrous metal, attacking or destructive agencies in the nature of oxidation, corrosion, erosion, etc., are always present and have their detrimental effects in varying degrees. Mine pumps and apparatus for chemical industries have been made of either steel, cast iron, brass, bronze, lead, or a combination of them. Brass and bronze have proved under ordinary working conditions to be, in the majority of cases, superior to steel or cast iron, while lead or antimonial lead is superior to brass or bronze. However, none of the metals mentioned gives satisfaction when used in the manufacture of mine pumps; in other words, none of them will stand up for a reasonable period of time against the attack of corrosion and erosion.

It is common knowledge that an alloy containing approximately equal parts of cobalt and tin, is practically acid proof, but such an alloy would be too brittle for mine pumps or chemical apparatus, and the price would be almost prohibitive. Alloys of copper, nickel and tungsten are also highly resistant to sulphuric acid in different strengths. High-silicon ferrous alloys containing 14 to 15 per cent of silicon, are also resistant to sulphuric, nitric and other acids, but on account of their physical properties, that is, excessive hardness and brittleness, their use is limited.

Paper presented before the Indianapolis section of the American Society of Mechanical Engineers, Oct. 28, 1921.

A true acid-resisting alloy to be a commercial success should be a good foundry proposition—a metal that gives a dense structure, free from a tendency toward segregation on cooling; that pours well; does not form excessive oxidation in the melting; does not burn the sand in pouring; takes a good impression of the mold; has a normal shrinkage, and gives castings which are easily cleaned. The metal or alloy should be a good machine shop proposition; that is, should machine well and not be too hard. Some acid resisting metals especially ferrous, pour well but are too hard and brittle to machine and consequently their field of usefulness is limited. Also such a metal or alloy must have certain physical properties which are under control and which enable the manufacturer to comply with any reasonable specifications that may be called for, such as degrees of toughness, malleability and strength. In the form of castings, bar stock, plates, etc., it must be reasonable in price. Therefore, outside the cost of the virgin metal used for such a metal or alloy, the other three major points indicated here have a great deal to do with the cost of the parts made.

Experiments Made

Three or more years ago, the Midwest Engine Co. requested its metallurgical department, of which I have charge, to conduct experimental work along the lines of an acid-resisting metal to be used in its pumps supplied to the different coal mines in the anthracite and bituminous regions. Such tests naturally dealt more especially with sulphuric acid. Heretofore most of the pumps were made of so-called acid-resisting bronzes but their duration was short, especially in certain districts where the mine water was very bad. For example, in mine waters with free acid, ranging from 13.67 grains per gallon in one particular instance to 91.96 grains per gallon in another, and from 74 grains of mineral matter per gallon to 479 grains per gallon, it is difficult to retain a pump in good working condition for any reasonable length of time, withstanding the action of the acid and also the erosion from mineral solids in suspension in the water. Therefore, we started our laboratory tests with the purpose of finding a metal or alloy which would comply with the four major points previously described.

Our experience along these lines first taught us that when comparative tests on acid-resisting metals are to be run, the samples must be divided into three classes, namely, rolled and drawn stock; those which must be cast under pressure, by which is meant the use of heavy risers, which sometimes weigh more than the casting itself; and castings poured in the ordinary way or following along the lines of usual procedure in a brass foundry. This was done because widely different results both as to the acid resisting qualities and the physical properties were obtained on the same alloy poured differently. Monel metal is an illustration. In testing this metal in sulphuric acid of different strengths and temperatures, it was found that the degree of resistance was greater in the rolled and the cast-under-pressure stock, than in the ordinary cast metal. The physical properties were high in the first and second instances but low in the third. The average results of a number of test bars poured under pressure were as follows:

Yield point (lbs. per sq. in.) 37,000
Tensile strength, (lbs. per sq. in.) 72,000
Elongation in 2 inches, 34 per cent
Reduction in area, 32 per cent

When cast without pressure the tensile strength was found to be 25,750 pounds per square inch with low elongation and reduction in area. Monel metal gives the highest test when poured under the highest pressure. The same conditions were noted with the various other alloys, consequently, we now only pay attention to the physical properties of test bars which give the true working conditions under which the castings are made. It also was noticed that the rolled and drawn metals and those poured under pressure and with chills, resists the corrosive and erosive action of mine water to a greater degree than do metals cast in the ordi-

nary way. This is, of course, on account of the finer structure or closer grain in the former. In other words, when the cast metal is in the granular form, the corrosive action is much greater, owing to the easier access of penetration, than in the more dense or fibrous form of structure, where the penetration is naturally more difficult.

Penetration Shown

A good example of the penetration and absorption of an acid solution, in a coarse-grained metal, and the care which must be exercised to eliminate any salts or adherent acid before weighing, is a sample of an acid-resisting metal immersed in a concentrated solution of sulphuric acid for 500 hours. When the test was complete, the sample was removed from the solution, carefully washed in the usual manner in distilled water and weighed. The loss in corrosion was 1.460 per cent. However, within 24 hours after this weighing, the dry sample showed a slight incrustation of sulphates on the surface. The sample was then placed in a beaker of distilled water where it remained for 24 hours, to remove any remaining acid or salt formation. The water, at the end of this time, was distinctly acid, and then the sample was again dried and weighed, the loss from the original weight was 2.003 per cent and the difference from the first weight after the test was 0.543 per cent. This instance demonstrated the great care which must be exercised to obtain a clean sample after tests are made. It also demonstrated the fact that this particular piece contained exceedingly open or coarse structure at the center, or perhaps some segregation.

Structure Major Point

In consequence, we have come to the conclusion that the structure or grain of the metal or alloy is the major point in its acid resisting qualities. This applies to ferrous and nonferrous metals alike. With metals such as copper, tin, lead, zinc, nickel, antimony, etc., their structure may be referred to as dense and in most instances, fibrous, while the cast alloys made up of these metals may be referred to as fine, medium or coarse grained. In the majority of cases, these cast alloys are coarse grained and because of this coarseness of grain many acid-resisting alloys do not work out satisfactorily. Also the different alloys, when poured in a chill mold resist the action of corrosion and erosion to a greater extent than when poured in a sand mold, and when poured in a green-sand mold, more than in a dry-sand mold. As an example of the difference in their resistance to acid, in testing the metals separately, virgin copper, when placed in concentrated sulphuric acid (sp. gr. 1.84-Be 66°) at room temperature, was readily attacked within 24 hours; when placed in a 30 per cent solution (Sp. Gr. 1.224-Be 26.5°) the action in 30 days was almost negligible; and in a solution of 10 per cent sulphuric acid (Sp. Gr. 1.070-Be 9.5°) the action in 30 days was only slight. The same conditions were found to exist with nickel, tin and antimony. Zinc was readily attacked by concentrated sulphuric acid, however, more especially so in the 30 per cent and 10 per cent solutions. When the foregoing metals were cast in the different combinations, for example:

	Per Cent			
	Copper	Tin	Zinc	Lead
Standard Bronze	88	10	2	
Standard Red Brass	85	5	5	5
Yellow Brass	59	3	38	

also alloys with copper or nickel base plus zinc, with small percentages of iron and silicon, etc.; it was observed that within 24 hours they were readily attacked in the same strengths of acid solutions mentioned.

Grain Important

As another example, two samples designated as *A* and *B* of approximately the same weight, were obtained from an acid-resisting alloy and were so machined that sample *A* exposed more of the outside or closer grained part, and sample *B* exposed more of the inner or coarser grained section. The two samples were then forwarded to the chemist of a mine in West Virginia, so as to enable him to test them in the running mine water, which test we consider as much nearer to the actual working conditions of a pump than our laboratory tests. The results obtained were as follows:

Sample	Per Cent
A lost in 14 days	1.78
A lost in 28 days	2.35
B lost in 14 days	3.68
B lost in 28 days	4.63

So the loss in the coarser grained sample was approximately twice that of the one with the finer grain.

We have succeeded in producing an alloy of a dense structure, which is practically immune to the action of sulphuric acid of different strengths and temperatures. This metal also has been tested in the worst kind of mine water, with gratifying results. Tests were made on it similar to the tests on the samples *A* and *B* previously mentioned, covering periods of 14 and 28 days, as follows:

	Per Cent
Loss in 14 days was	0.05
Loss in 28 days was	0.13

The tests are being continued for 90 days, or as much longer as we obtain interesting results. The metal is a good foundry and machine shop proposition and the price is moderate. Thus three of the four major points of the requirements for a satisfactory acid-resisting metal are complied with in this case. At the present time we cannot give this metal the strength necessary to withstand the ordinary wear and tear of mine pumps.

In dealing with synthetic alloys we have a great deal of trouble with segregation, especially in our larger castings. An example of such segregation would be, in an alloy of copper, nickel and zinc, placing it in the nickel silver group. If a casting of this type has any free zinc segregation, it is immediately attacked by sulphuric acid, and the casting in a short time becomes useless.

In dealing with metals used in mine pumps, the laboratory tests and the actual working conditions are vastly different. In the first instance we are dealing with one destructive agency, namely corrosion, and in the actual workings of a mine pump we are facing the two destructive agencies, corrosion and erosion, and sometimes electrolysis. Therefore, laboratory tests have a tendency to give results which cannot always be relied upon. For instance, two samples of acid resisting metal were cut from the same piece in the same manner, and our laboratory tests covered the immersion of one of these samples in the mine water received from a mine in West Virginia. Our percentage of loss covering a period of 90 days was 1.200 per cent. The second sample was forwarded to the mine and placed in the running water for a period of 14 days, with a loss of 1.78 per cent.

Mine Water Malignant

Again, in the pumps which we have made of our acid-resisting metal we find from experience that in pumping sulphuric acid of various strengths and temperatures, we do not have as severe a condition as when pumping mine water.

A series of tests were conducted on the rate of corrosion for a definite period of time, by weight, at room temperature, in concentrated sulphuric acid, specific gravity 1.84 and a 10 per cent solution of the same acid specific gravity 1.07. Of the alloys tested those with a lead base were more resistant to dilute sulphuric acid solu-

tions than the copper-base and nickel-base alloys. The nickel-base alloy, and the copper-base alloy with nickel, were more resistant to the concentrated acid than to the more dilute form. Copper-base alloys with tin and zinc, also copper-base alloys with zinc were readily attacked in both solutions.

Few known metals or alloys will resist the action of nitric acid or a combination of nitric with other acids, and the general use of these few is either prohibited by their rareness and cost, or they cannot be produced in such a way as to make them interesting from a commercial standpoint. In this instance mine pumps and accessories, also apparatus for the chemical industries, etc., are referred to.

When considering the metals and alloys which are required to be highly resistant to the effects of corrosion and erosion, it must be borne in mind that to cover a broad field and therefore be a commercial success, the metal or alloy will have to be of such a nature that it can be easily cast, rolled, drawn and machined so that all parts of a pump or other apparatus can be readily made of it, otherwise the field covered by such a metal must be more or less confined and limited.

The problem is still in its infancy, and those who are desirous of obtaining satisfactory results along the lines of acid resisting metals or alloys, should keep in mind the fundamental principles involved and note some of the obstacles that present themselves from different angles which have been noted in this article.

Committee Organized To Study Sand

Efforts of the American Foundrymen's association to secure co-operation in the study of molding sands has resulted in the formation of an advisory committee by the Foundrymen's association and the engineering division of the National Research council to consider the problems encountered by the foundrymen in their use of molding sand and furnace refractories. On this committee are representatives from the various branches of the foundry industry, the U. S. bureau of standards, the U. S. bureau of mines, the U. S. geological survey, the Canadian department of mines, the American Ceramic society, and noted metallurgists, geologists and ceramists from commercial organizations and universities.

At an organization meeting held in the office of the National Research council, in New York, Oct. 28, an executive committee of seven members, representative of the various interests, was selected. Those asked to serve on this committee are:

R. A. Bull, chairman; W. R. Bean, president, American Foundrymen's association; George K. Burgess, bureau of standards; Henry B. Hanley, metallurgist and chemist; Jesse L. Jones, Westinghouse Electric & Mfg. Co.; Henry Ries, consulting geologist; Bradley Stoughton, consulting metallurgist.

Robert E. Kennedy, assistant secretary of the American Foundrymen's association was designated as secretary of the molding sand research committee. The following men have accepted appointment on the main committee:

R. J. Anderson, U. S. bureau of mines experiment station, Pittsburgh; G. A. Bole, U. S. bureau of mines station, Columbus, Ohio; R. A. Bull, consulting engineer, Sewickley, Pa.; G. K. Burgess, U. S. bureau of standards, Washington; Henry A. Carpenter, General Fire Extinguisher Co., Providence, R. I.; L. H. Cole, mines branch, department of mines, Ottawa, Canada; J. C. Davis, American Steel Foundries, Chicago; George K. Elliott, Lunkenheimer Co., Cincinnati, O.; Howells Frechette, department of mines, Ottawa, Ont., Canada; J. E. Galvin, Ohio Steel Foundries, Lima, O.; M. I. Goldman, U. S. geological survey, Washington; A. E. Hammer, Malleable Iron Fittings Co., Branford, Conn.; H. B. Hanley, New London Ship & Engine Co., New London, Conn.; R. F. Harrington, Hunt-Spiller Mfg. Corp., Boston; H. W. Highriter, Eastern Malleable Iron Co., Naugatuck, Conn.; Jesse L. Jones, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; C. P. Karr, U. S. bureau of standards, Washington.; H. M. Lane, the H. M. Lane Co., Detroit; R. L. Lindstrom, Canadian Car & Foundry Co., Montreal, Quebec, Canada; J. Spotts McDowell, Harbison-Walker Refractories Co., Pittsburgh; Richard Moldenke, metallurgist and foundry consulting engineer, Watchung, N. J.; C. W. Parmelee, ceramic engineer, University of Illinois, Urbana, Ill.; Ross C. Purdy, organizing secretary, American Ceramic society, Columbus, O.; Henry Ries, geologist, Cornell University, Ithaca, N. Y.; Walter M. Saunders, Saunders & Franklin, Providence, R. I.; Homer F. Staley, Metal & Thermit Corp., New York; Jesse L. Stoddard, Detroit Testing Laboratories, Detroit; R. W. Stone, U. S. geological survey, Washington; Bradley Stoughton, consulting metallurgist, New York; Enrique Touceda, consulting metallurgist, Albany, N. Y.; De Gray White, Niles-Bement-Pond Co., Plainfield, N. J.; Fred L. Wolf, Ohio Brass Co., Mansfield, O.

The first meeting of the executive committee was held Nov. 17 at the Engineering Societies building, New York.

Opens Foundry Addition

The Vulcan Foundry Co., Ambler, Pa. recently completed an addition to its plant. A section 95 feet long by 85 feet wide was added to the original building which was 60 x 120 feet. The opening of the new section was celebrated on November 8, by many of the company's customers and prospects who witnessed various molding and pouring operations. H. W. Brown of the Tabor Mfg. Co., Philadelphia, gave an address on the subject of machine molding compared with hand molding. The guests also were entertained at dinner served in the new building, which was prepared by the caterers on the foundry salamanders.

Publishes New Bulletin

The Engineering Advertisers association of Chicago is now publishing a monthly bulletin in the interest of its members. The bulletin gives a digest of the speeches made at the various meetings and also includes other information and facts regarding the movement of goods from industry to industry, personal notes, etc.

Daubing Is Responsible

Question: Our cupola is lined to 40 inches, but by the time we drop the bottom, the opening above the tuyeres has narrowed down to about 12 inches. We use a good grade of coke, the iron comes hot and the slag flows quite freely. The clay employed for patching the cupola is not all that it should be, in fact it is completely eaten away at the conclusion of even a small heat and we are wondering if that is the cause of our trouble. How much limestone should be used on a 2000-pound charge? What can be done to insure a clean drop? What, in your opinion is the best mixture for repairing a cupola wall at the melting zone? What may be added to fire clay to increase its strength? What do you think of the practice advocated in a recent issue of THE FOUNDRY of mixing from 5 to 10 per cent aluminum filings with the daubing clay?

Answer: From the fact that the iron and slag run hot and fluid it is apparent that your charging conditions and methods are correct. Many things may cause bridging of the cupola, but as these factors usually are reflected in

the fluidity of the iron and slag, and in the melting speed we arrive by the process of elmination at the probable cause, the character of the material used for daubing. If the daubing at the melting zone does not outlast a short heat, it is evident that it is not of a sufficiently refractory character. Clay of this kind has a comparatively low melting point. However i does not melt hot and fluid like the ordinary limestone slag. Dropping down, thick and viscid it comes in contact with the blast and gradually chills and builds out toward the center.

The obvious remedy is to employ a more refractory daubing material and one which, when it does melt, will unite readily with the limestone slag.

The experiments conducted by Carl Buberl, an account of which appeared on page 533, July 1, THE FOUNDRY, would seem to indicate that aluminum filings added to fire clay in the proportion of 4 per cent increased the refractoriness and wearing quality of the clay to a remarkable extent.

Usually about 50 pounds of limestone may be used where the iron charges are made up of 2000 pounds. However, limestone varies in different localities, the ash content of coke varies from time to time, whether sand or machine-cast, pig iron is used, are factors which must be taken into consideration. The proper amount of limestone to use is the amount that will produce a thin, fluid slag and this point may be determined by a little experimenting.

British Research Body Issues Monthly Report

The official report issued by the British Cast Iron Research association in connection with its research department states that during the month of October the following problems have been submitted by members of the association and are being investigated by the Director of Research: Pyrometers for foundry work, dead soft gray iron of non-brittle character, facing and green sand mixture for heavy semisteel castings, causes of fracture in heavy gray iron castings, defects in malleable iron castings, and their remedy, correct method of running and gating semisteel castings of intricate design, difficulties in cupola practice when melting white iron and means for minimizing the trouble, foundry floor-sand composition for heavy iron casting work, sponginess in malleable castings, and defects in heavy intricate engines facings.

In addition to this a number of researches already reported upon are in progress. The information bureau now is being used by members requiring data or information upon every phase or routine foundry work and its usefulness is greatly appreciated. All the technical papers and publications issued in any part of the world incidental to foundry work are constantly received, abstracted and indexed. Further additions of technical books have been made to the library.

Will Continue Manufacture of Sand Blast

J. M. Betton, who has been appointed sales manager of the Hoevel Mfg. Co., 154 Ogden avenue, Jersey City, N. J., will continue the manufacture and sale of injector sand blast at 59 Pearl St., New York.

Opens New Offices

The Combustion Engineering Corp., 43 Broad street, New York, has opened two new branch offices, one at 216 Latta Arcade, Charlotte, N. C., in charge of T. E. Nott, and the other at Seattle, Wash., where the company is represented by the Fryer-Barker Co., 1133 Henry building.

Publishes Report on Uses of Zirconium

On account of various mysterious properties and uses that have been attributed to zirconium, an investigation regarding the preparation and uses of metallic zirconium and its salts has been conducted by the United States bureau of mines, and the results are made public through Bulletin 186, by J. W. Marden and M. H. Rich.

The compounds of zirconium have numerous important uses and more uses doubtless will be found. Investigations in recent years have indicated that sintered or coherent zirconium metal is resistive to acids; that it can be used for electrodes, and it probably will find metallurgical uses. A steel containing zirconium has been proposed for use in armor plate and automobile parts, and nickel-zirconium alloys have been suggested for high-speed cutting tools and for cutlery. Numerous articles in scientific journals have recommended the use of zirconium oxide as a refractory, an abrasive, a pigment in paints, and as an opaquing agent in enamel ware.

Zirkite firebrick are used for furnace lining as well as for other purposes where a refractory having a low coefficient of expansion, high melting point, and maximum resistance to slag corrosion is demanded. As an abrasive, zirconia, zirconium silicide and zirconium carbide are suggested for a variety of uses, the carbide particularly as a substitute for the diamond in cutting glass.

Coherent white zirconium metal, on account of its acid-resisting properties, has been suggested as a substitute for platinum in certain cases. Its alloys have been suggested in the manufacture of rust-resisting apparatus.

The best-known zircon deposits in the United States are near Green River, Henderson county, N. C., and in the Wichita mountains, near Cache, Okla. Zircon is found most abundantly in certain syenites of Norway, and occurs in crystalline limestone at Greenville and elsewhere in Canada. Dana states that zircon occurs in various localities in North America, including Litchfield, Md.; Essex county, Orange county, and in St. Lawrence county, N. Y.; near Reading, Pa.; abundantly in the gold sands of Burke, McDowell, Polk, Rutherford, Henderson, and other counties in North Carolina; with astrophyllite, etc., in the Pikes Peak region in El Paso county, and at Cheyenne Mountain, Colo.

Metal for Breakshoes

By H. E. Diller

Question—We are having difficulty in supplying brakeshoes to give sufficient wear, and would like to know which of the following mixtures would give the better wear:

Mixture No. 1.

	Per Cent
Silicon	0.840
Sulphur	0.121
Manganese	0.360
Phosphorus	0.338

Mixture No. 2.

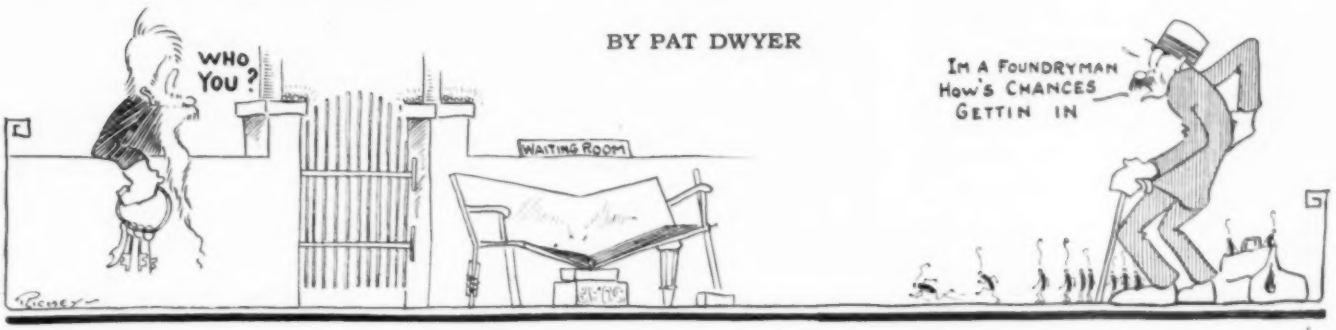
	Per Cent
Silicon	1.450
Sulphur	0.250
Manganese	0.240
Phosphorus	0.145

Answer—Iron of the analysis No. 1 would be better than iron of the composition of No. 2 because the sulphur in No. 2 would be apt to cause the brakeshoes to crack when they get heated from braking. However, neither composition is to be recommended. Brakeshoe manufacturers have come to the conclusion it is better to have a softer iron and many of them cast steel inserts in the brakeshoes and use an iron with 1.5 to 2 per cent silicon, sulphur not over 0.12 per cent, phosphorus between 0.3 and 0.7 per cent and manganese between 0.5 and 0.7 per cent.

F. C. Richmond Machinery Co., 117 W. Second street, Salt Lake City, Utah, has been appointed to represent the Orton & Steinbrenner Co., Chicago, manufacturer of locomotive cranes and handling machinery.

Bill Enlarges Upon a Bevel Gear Wheel

BY PAT DWYER



ABOU BEN ADHEM, if my memory serves me correctly, is the name of the gent frequently held up for our emulation. Your memory, probably equal to mine, in all respects, will remind you that when St. Peter asked Ab for his credentials our hero modestly cast down his eyes, gestured deprecatingly with both hands and remarked that he never had performed any meritorious deeds worth mentioning, but he always had made it a point to love his fellow men.

I cannot hope to get by on A. Benjamin's alibi for I have been gouged cruelly on sundry and divers occasions by some of these same fellow men and I know that had I lived at an earlier period I should have been a happy, stanch and enthusiastic supporter of the old Mosaic law, an eye for an eye and a tooth for a tooth. However, if I cannot qualify on one count I hope to on another.

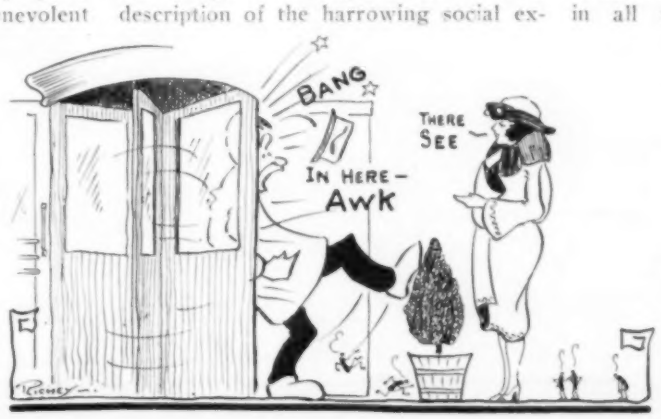
When I tell the kindly old guard on the pearly gates that I spent so many years in the foundry I fully expect to see the suspicious light die out of his eyes to be succeeded by a glance of tenderness and pity. When I direct his attention to the hump on my back, acquired through stooping over jobs bedded in the floor, and to my bandy legs resulting from carrying heavy ladles of metal in the days of my youth before my bones had properly set; when I peer up at his benevolent whiskers through a pair of dim and rheumy eyes contracted through groping around like a mole in dark and dismal foundries, I fully expect that he will take me by the hand and say: "Come in my boy, come in; you have had your share of purgatory already." It seems almost too much to expect, but if he asks me if I have any preference in the choice of a seat, I shall select one in close proximity to a fan, where I can have a free and uninterrupted view of certain parties I wot of working on a little narrow floor with a 10-ton ladle pouring open sand plates on both sides of them all day long. I never have drawn a prize as a singer, or been kissed on both cheeks and decorated with the cross of the Legion of Honor in recognition of my ability as a harpist, but under such a beatific combination of circumstances I feel confident that I could supply both words and music for that grand old line from the Psalmist "Oh Grave where is thy victory! Oh Death, where is thy sting!"

In the remote event that my first plea does not get me past the barrier, I have what I believe is known in sporting circles as an ace in the hole. I shall tell St. Peter that I never was unduly concerned in the affairs of my neighbors, and, to pursue the simile set forth in the preceding sentence, that should do the trick. I sincerely trust that the august bearer of the keys does not wax inquisitive and cross examine me too closely for on occasion I have attended with a polite show of interest while a certain intimate lady friend has commented on current neighborhood events. I never have been able to decide whether she lets me in on this inside stuff as a form of entertainment or just because she likes to hear herself talk. The other night she regaled me with a description of the harrowing social experience of a young lady who lives in our vicinity.

Kathryn met a perfectly swell young man at a dance. His hair was combed back as slick as a mouse; he wore his clothes like one of those Hickyheimer boys; he could put down his feet and pick them up like a cat doing sentry duty on the back fence on a dark and rainy night; and as a toddler he led the field. He made a date with Kathryn to dine at a downtown restaurant on the following night and afterward attend a performance at one of the theaters. On the way down town he inquired solicitously if the lady had any preference in restaurants and on the strength of his appearance she indicated an exclusive place where she had been on a few special occasions.

Everything went smoothly until they approached the restaurant and then Kathryn experienced a succession of shocks that completely wrecked a perfectly good evening. Democrat though she is, the germ of doubt is beginning to develop in her mind and she is led to wonder if perhaps there is not some basis of truth for the statement sometimes set forth that it takes three generations to make a gentleman. The term gentleman, in this instance having no reference to a man's ethical or moral standards, but simply having reference to one who is thoroughly house broken and who is highly skilled in all the little tricks, airs, graces, minor hypocricies, and table manners that make life one grand sweet song.

In his desire to keep close to the lady he squeezed into the same compartment in one of these revolving doors and came within an ace of losing the tail of his coat and part of his anatomy in the operation, besides stepping on the lady's heel and causing her to enter the room as if she had been shot out of a gun. She instinctively paused by the check



ONE GOOD TURN DOES NOT ALWAYS DESERVE ANOTHER

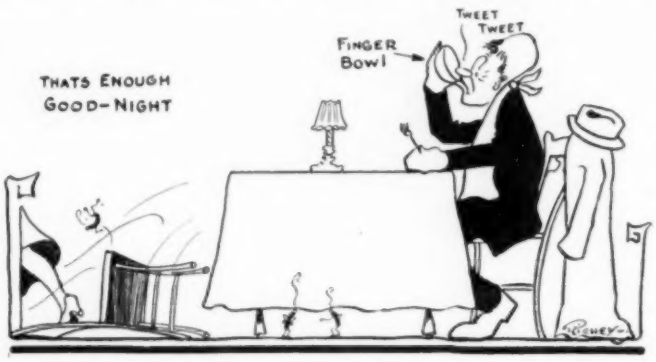
room and also looked around for the captain to assign them to a table. These trifles meant nothing in our hero's young life. He led her to the nearest unoccupied table, draped his overcoat over the back of the chair and placed his hat under the table. He handed her the menu and invited her, with no regard to the acoustic properties of the place and quite as if expense was no object, to go as far as she liked.

By this time Kathryn, agonizingly aware of partly concealed amused glances thrown in her direction from diners at adjoining tables, had about as much appetite as a young humming bird in the last stages of galloping consumption. She was wondering desperately how she might escape without rendering herself unduly conspicuous. With admirable self-control she intimated faintly that she was not hungry and would be pleased if he should do the ordering. He turned to the large, dignified colored gentleman with the napkin on his arm who had silently appeared near the table and with what he considered a regular man-about-town air, a trifle condescending, but with just the proper degree of familiarity, said:

"George, the lady is a little off her feed tonight, so you can just bring us a couple of these here rag outs, a few side dishes of vegetables, apple pie and coffee, and say, George,—make it snappy."

Whatever our hero's limitations, no one could conscientiously claim that he was not a two fisted he-man,* displaying an equal speed and dexterity with either knife or fork. 'Tis true he handled his fork at times as if it was a dagger, but the easy and graceful manner in which he elevated his elbow and deposited a knife full of food where it was calculated to do the most good, was a poem in itself and would lead a disinterested spectator to the conclusion that at one time he had served an apprenticeship as a sword swallower.

Even the most delightful parties must come to an end some time and with a view of accelerating their departure Kathryn ostentatiously drew on her gloves. Just as she was snapping the last catch into place she was horrified to observe the waiter bearing down in their direction with a pair of finger bowls. She turned white, then pink and in the space of about two seconds suffered enough mental torture to compensate for the combined iniquities of at least three ordinary life times.



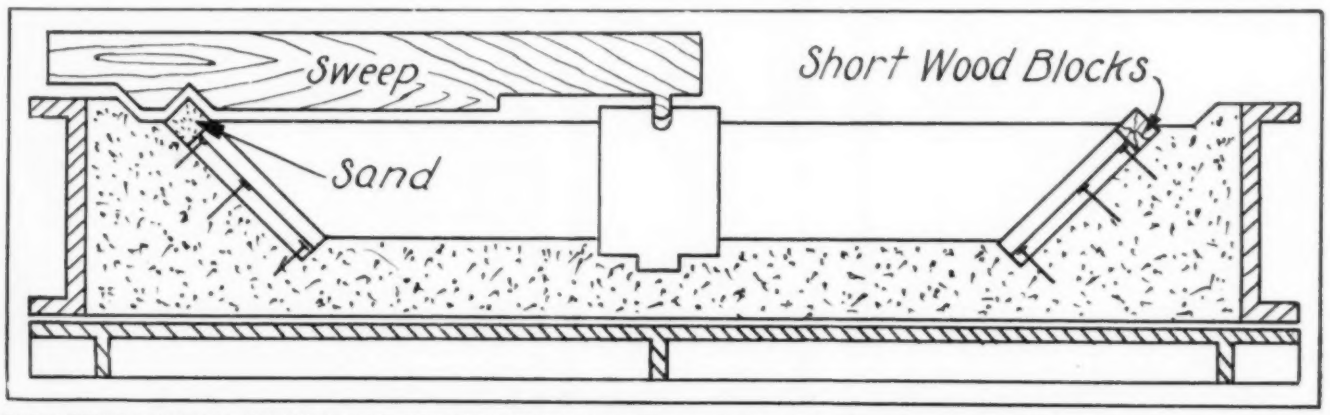
ONE OF THE MANY REASONS WHY GIRLS LEAVE HOME

Not the least bitter of her reflections was the thought that the spectators had noted his dreadful *faux pas* and would set her down in their minds as a fit companion for the juggler. At first she was minded to carry the situation off with a high hand, rise and move to the door. Then she was seized with a panic as she felt her knees giving way, so she dropped her hands into her lap and under cover of the table frantically tried to remove the gloves before the waiter arrived at the table. At the expense of two buttons and much anguish, mental and physical, she at length succeeded and then to her dismay the waiter passed by and laid his burden on an adjoining table before two other guests.

By this time her escort had lighted his cigaret. He called the waiter, handed him a $5 bill, told him with a wave of the hand to keep the change, shook himself into his coat, put on his hat and said to the girl: "Well that little job's done; let's go!"

She has no distinct recollection of how she reached the door, or whether she pulled on her gloves or not, but once outside she made a dash for a passing car and now, to slightly paraphrase the experience of one of our favorite heroes of fiction, she wakes up occasionally at night tingling with humiliation, with the strength gone from her limbs and apparently a huge and gaping vacuum where her heart should be. No my dears, oxen and wain ropes could never drag her back to that accursed restaurant. Now as I said before it is only from an innate sense of courtesy and through a desire to live up to the spirit and terms of the marriage contract—you know, love, honor and listen,—that I become aware of current neighborhood events and having done my duty faithfully in this respect I forget them as speedily as may be. Therefore, when Bill met me a few days afterward and started to tell me the same story I told him it was all old stuff and I was not interested.

"Well," said Bill, "So far as I can see there is no occasion of arching your back and showing your claws like a tom cat. I merely wished to use the incident as an illustration of the half baked condition in which many men are content to go through life. You probably may say that where ignorance is bliss, it is folly to be wise, but a fair share of knowledge is not difficult to acquire and every item adds to a man's usefulness and incidentally to his opportunity for enjoying more of the comforts of life through increased remuneration for his services.



THE TEETH MAY BE EXTENDED EITHER BY LAYING A ROW OF SHORT WOOD BLOCKS AROUND THE TOP OF THE RIM AS SHOWN TO THE RIGHT OF THE ILLUSTRATION; OR BY USING A SWEEP AS SHOWN TO THE LEFT OF THE SAME ILLUSTRATION

"For instance, consider our own business. The average boy learning the molder's trade is satisfied to put in the allotted four years with as little effort as possible. He performs his routine duties according to instructions, but displays no originality or initiative and takes absolutely no interest in the fundamental principles involved; or in the allied branches of the trade such as coremaking, mixing and melting metals. At the close of a four year term if he can put up the set day's work on a class of castings with which perforce he has become familiar, he considers himself a finished artisan and is content to let the rest of the world go by.

"Confronted with a new job he is up a tree temporarily if not permanently because his faculties have not been trained to adapt his knowledge to cope with unforeseen circumstances. Given the opportunity of taking charge of a shop and realizing his limitations he is obliged reluctantly to decline. The ability to handle men and willingness to assume responsibility are more important parts of an executive's job than the possession of mechanical dexterity and many otherwise competent mechanics are constitutionally averse to desiring or accepting a supervising position on account of one or both of these factors. These men always will remain cogs in the wheels of industry. Other men, inherently endowed with executive ability, find themselves severely handicapped if not actually barred from such positions by a lack of knowledge of the fundamental principles involved in the various processes.

"On several occasions recently I have touched on alternative methods for increasing or decreasing the face of a spur gear and the last time I had the pleasure of your company I employed a few well chosen expressions to describe how the face of a bevel gear might be decreased. Being a man of orderly and methodical habits who likes to finish one job before starting another, I think it is eminently fit and proper that I now should describe the usual method of increasing the face of a bevel gear.

"It does not follow necessarily that because a molder has learned to mold a gear in 57 different ways that he is entitled to affix three stars after his name. It simply may be regarded as evidence that he has done some thinking on his own account, that he takes a proper and legitimate pride in his skill as a craftsman, and that in all probability his trend of thought would render him competent to solve other problems of a like character.

"Assuming that the customer orders a wheel with a 9-inch face and the teeth on the only available pattern in stock are 7 inches in length. If the bars in the cope are, or can be cut out the pattern may be placed directly on the rollover board. However, it is usually the case, especially on large wheels that an iron cope will be employed and since in a jobbing shop the same cope may be used for hundreds of jobs in the course of a year it will be provided with plain, straight bars with the lower faces not more than ½ inch above the joint line.

In steel shops on account of the many large risers necessary, a set of bars for a round flask usually is cast in the form of a fairly open frame and bolted at several points to the flask ring. Round, iron copes in iron foundries usually are cast in one piece except in the largest sizes, where it may be necessary to cast the interior in several concentric rings joined by connecting bars and provided at several points with openings to allow for contraction and expansion. I may dwell on this feature at some future time, but at present we shall proceed on the assumption that the cope is of the usual type, that is cast in one piece with plain straight bars.

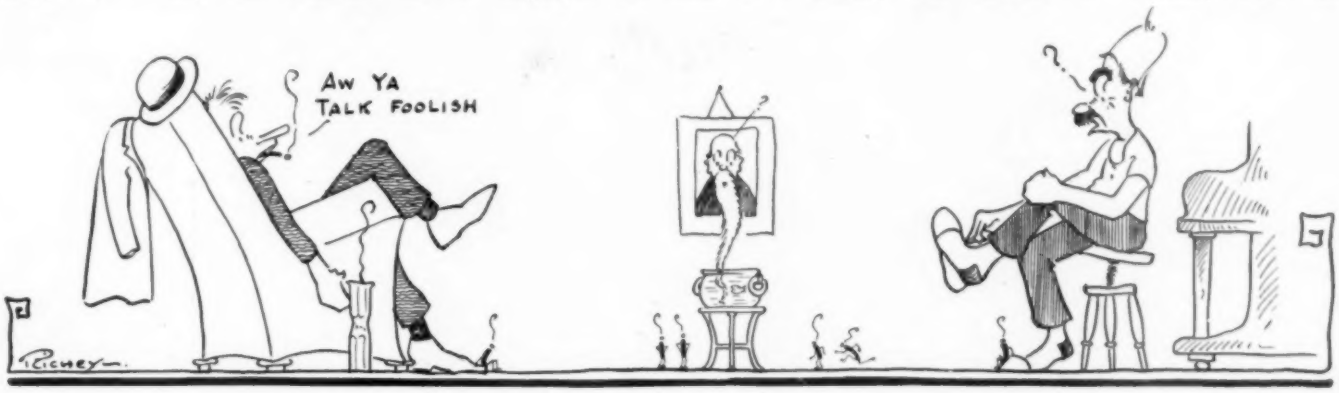
"To bring the highest point of the gear rim flush with the joint of the flask and thus keep it below the lower line of the bars in the cope it will be necessary to place a number of blocks approximately 2 inches high under the pattern where it rests on the rollover board.

"To secure a nice skin on the teeth, the facing sand should be passed through a No. 8 riddle. If the teeth are to be skin-dried this precaution may be omitted since the blacking will make smooth teeth even if the sand is passed through a No. 4 riddle. When the teeth are partly filled, it is advisable to set three nails, head down, in each tooth, one near each end and one in the center. If the nails are set point down there is danger of the ramming forcing them into the pattern with the result that the teeth will be torn up when drawing the pattern. The remainder of the teeth then are filled either by riddling additional facing from a height of three or four feet and pressing it down between the nails with the fingers; or by throwing the facing on, one handful at a time, until the teeth are covered. The drag then is filled with sand, rammed, vented and rolled over.

"The parting may be made in two ways. In the first, the sand is dug away from around the rim of the wheel in the regular manner. Then a number of short blocks, 2 inches wide and conforming to the circle of the wheel are cut on the band saw and placed in the hollow around the points of the teeth. The remainder of the joint is made as usual and the cope rammed and lifted off. It is apparent that the cope will bear an impression of a rim 2 inches wider than the original pattern.

"The second, a simple and more workmanlike method is to form the parting with a sweep. The outer edge of the sweep is made to rest on the rim of the pattern and the inner end is provided with a hole or socket that swings on the cope coreprint. If the cope coreprint is loose, it may be removed and then the inner end of the sweep can be fitted with a dowel pin to work in the coreprint dowel

(*Concluded on Page* 986)



TALK IS CHEAP WHICH EXPLAINS HOW SOME FOLKS FIND IT SO EASY TO SPEND THE EVENING

Preparing Sand for Auto Castings

A Thorough Mixing Method Adapted to the Core and Facing Sand is Responsible for the Production of Better Castings and a Marked Saving in Labor and Material

PROPER preparation and conditioning of sand in the foundry constitutes one of the most important steps in the process of producing perfect castings at low operating expense. Unless the sand is in proper condition to give the mold and core the necessary degree of strength and porosity, care exercised in other parts of the work is wasted and the resulting casting will be defective. This phase of foundry practice is worthy of the earnest attention of any foundry manager or superintendent. It may be regarded as a prime essential in economical operation and one that will yield gratifying returns if given the consideration which its importance warrants. This question has been solved in a satisfactory manner at the plant of the Packard Motor Car Co., Detroit, where the rigid specifications to which automotive castings must conform, combined with the necessity for economical production rendered the problem of serious proportions. Approximately 75 tons of core sand and 80 tons of dry sand facing are handled daily when the shop is working to capacity. The direct saving in labor cost on this quantity, comparing hand methods with the present method of machine mixing, amounts to a considerable item. No direct records are available illustrating the scrap loss directly traceable to improperly tempered sand under the former method of hand mixing, but the management is of the opinion that it amounted to a considerable percentage of the total.

FIG. 1—THE MEN BEHIND THE PACKARD CASTINGS

Left to right, Frank Hitzelberger, core room foreman; Jack Lean, castings cleaning room foreman; Charles Fein, assistant foreman, iron foundry; Paul Romph, aluminum foundry foreman; Fred Erb, foundry manager; A. Bassler, brass foundry foreman; Otto Larsen, iron foundry general foreman; Fay Carpenter, iron foundry foreman; R. M. Scott, foundry superintendent.

New sand for molds and cores is unloaded from the railroad cars by a locomotive crane equipped with a grab bucket. It is dropped through hatch ways in the roof over the sand bins located on the opposite side of a covered roadway from one of the side walls of the foundry building. Wheelbarrows and electric trucks are employed to move it as required from the bins to the respective sand mixers. After it has been mixed according to a definite formula which embraces time as well as materials, it is moved by the same agency to the individual workmen's benches or machines.

The core sand is mixed in a 6-foot Simpson pan made by the National Engineering Co., Chicago, equipped with a bucket loader operated by a clutch connection on the shaft of the mixer. The bucket is designed to hold the maximum amount that can be handled in the pan at one time and it is claimed that this feature saves considerable time and also insures a more uniform mixture. It removes the hazard of forgetfulness always present when the matter of counting the measures, shovel or bucketful, and binder is left to the discretion of the operator. Another advantage claimed for this method is that since a sufficient quantity of material for a batch is dumped into the pan at one time and then milled for a definite period, the entire quantity will be uniform.

Mixed Not Crushed

To provide a free vent in the cores it is essential that the individual grains of sand should not be crushed and it has been found by experiment that the desired result can be accomplished by allowing the pan to revolve for two minutes. It also is stated that the combined plowing and mulling action of the rollers thoroughly incorporates the binder so that each grain is covered with a film of oil, in the same time.

Some interesting figures are submitted in this connection. For instance, where formerly the core sand required the services of 5 men and cost $0.50 a ton it now is prepared by two men, wheeled in and delivered to the core makers for $0.25 a ton. Formerly oil in the proportion of 1 to 60 was required to give the cores the necessary strength. This has been reduced to a ratio of 1 to 70. Based on a daily consumption of 75 tons, the saving by this method of mixing amounts to $18.75 a day. Facing sand for dry sand cylinder molds is prepared in another mixer of the same make, also equipped with a bucket loader. This practice has been adopted as the result of experience which shows that the composition of the sand and the manner in which it is mixed determine to a considerable extent whether the castings produced go to the machine shop or the scrap pile. The same factors also determine whether the skin of the casting peels clean or presents a rough and dirty appearance.

The present method of mixing the dry sand facing has resulted in reducing the amount of new sand required by about 50 per cent. Also with fewer men it is possible to keep from 1 to 2 hours' supply of facing always ready ahead of requirements. While the Packard practice is not based on the claim that all automobile cylinders should be made in dry sand molds, comparative costs indicate that under certain conditions and where a definite standard of appearance is reckoned as a factor, dry sand molds are preferred.

With the facing sand, also, it has been found that a 2-minute mixing period yields a satisfactory composition. The necessary bond is furnished by sprinkling each batch while in the pan with a water soluble binder. It has been the experience of the Packard

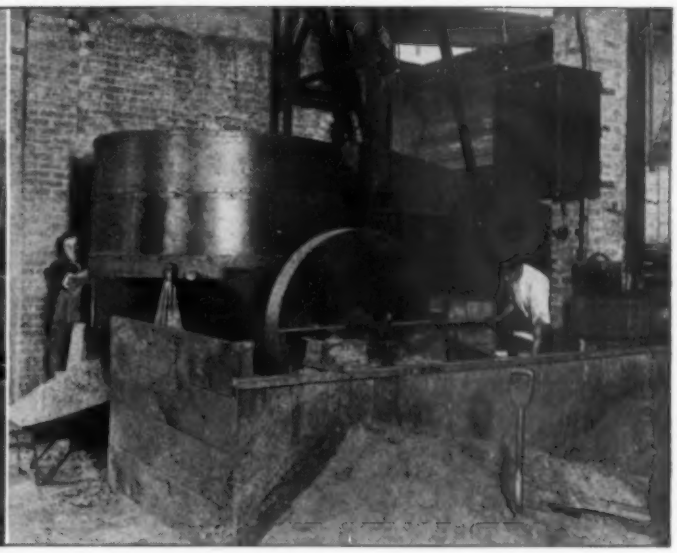


FIG. 2—THE DRY SAND FACING IS PREPARED IN A SPECIAL MULLING MACHINE FIG. 3—CORE SAND MIXER FOR PREPARING AND MIXING THE BINDER THOROUGHLY WITH THE SAND

Co., that dry sand molding involves little more expense than green sand on this particular job and this expense is more than offset by the advantages of the method. It is an insurance against cuts, scabs, blows, drops, hard spots and eliminates the use of chaplets. After the mold is dried, the cores are set in and pasted and then the mold is placed back in the oven until the paste has hardened.

Comparative costs indicate that where formerly four men were employed to mix dry sand facing at a cost of $0.40 a ton delivered to the molding machines, two men now handle all the material and this factor added to the reduction in the amount of new sand necessary has lowered the cost of preparing the facing sand to be delivered to the molders to $0.20 a ton. Under the hand mixing method new and old sand were used in the proportion of 50 per cent of each. Under the present method it has been found that new sand, 20 per cent and old sand 80 per cent makes a satisfactory mixture. From the foregoing it is apparent that the saving effected on facing sand amounts to $16.00 a day and in both core and facing sand it amounts to $34.75.

Exclusive of the cylinders, all the remaining castings are made in green sand molds. In some cases this also means that the cores are made in green sand and in other instances only the bottom half of the core is made in dry sand, the other half being blocked or topped in green sand. Many of these castings are made in molds where the pattern is covered with a regular green sand facing containing coal dust in the proportion of about 1 to 10. On others, no coal dust is required. All the green sand facing, whether containing coal dust or not is mixed in a 4-foot pan equipped with a bucket loader, made by the National Engineering Co.

The clutch housing shown in the right fore ground of Fig. 4 and the aluminum crankcase shown immediately back of it are examples of castings in which both mold and cores were made in green sand without the addition of the coal dust facing.

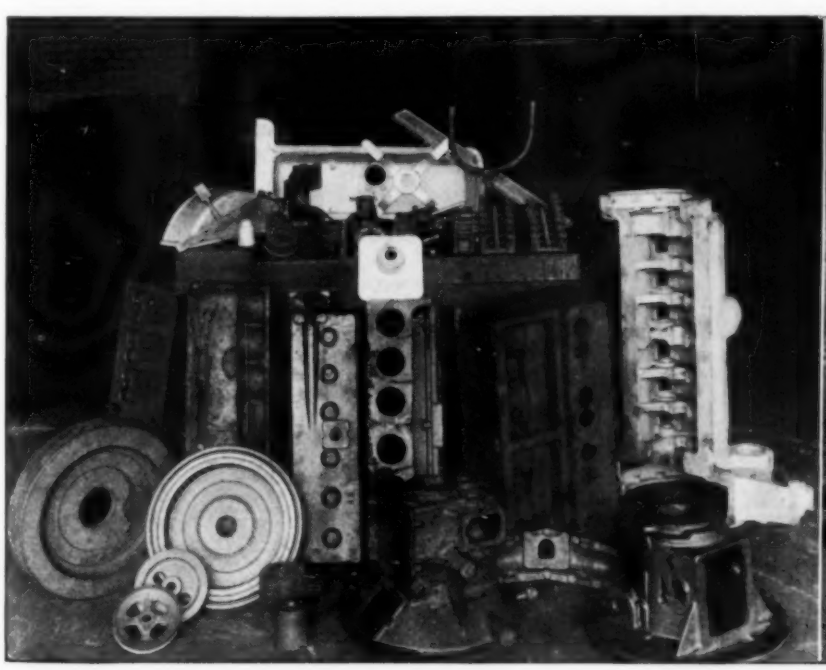


FIG. 4—WITH THE EXCEPTION OF THE TRUCK AND PASSENGER CAR CYLINDERS SHOWN AT THE RIGHT AND LEFT, RESPECTIVELY, ALL THE CASTINGS ARE MOLDED IN GREEN SAND FIG. 5—ALL THE GREEN SAND FACING IS PREPARED IN A 4-FOOT MIXER EQUIPPED WITH A BUCKET LOADER

GermansShowNewFoundryEquipment

BY C. IRRESBERGER

FOLLOWING the successful example of the American Foundrymen's Association, a foundry exhibition was held in Dresden, Germany, last year. This year a much more extensive exhibition was arranged for late September, coincident with the annual meeting of the Verein der Deutschen Eisengiesserei'en at Munich. In addition to molding machines. which were in operation, foundry equipment of many other kinds were shown by the 160 exhibitors.

Molding machines predominated. Those shown included machines operated by hand, electricity, compressed air, hydraulic pressure and by belt driven transmission. It is interesting to note that while hitherto the hydraulically operated machines were favored in German foundries, jar-ramming machines with widely different power sources have been developed. Some of the machines exhibited closely approached the American types, though many were developments of thoroughly new ideas. The jar-ramming machines demonstrated had three notable features, namely:

Independence of the jar-ramming table from the lifting device during ramming.

Accessibility of the mold from every side, permitting the finished mold to be lifted by crane or hoists.

Designs shown permitted the jar ramming machine to be served from a mechanical sand filling system.

Principles of Electric Units

Figs. 1, 2 and 5 show an electrically operated shockless jar-ramming machine built by the Schwabische Huttenwerke, Wasseralfingen, Germany. The machine is worked by a spur wheel countershaft running in an oil bath *A*, Figs. 1 and 5. The lift is actuated by a cam which also runs in oil. The jolt table falls on a cast anvil which rests on four strong cylindrical springs *E*. By this arrangement the jar is absorbed before reaching the foundation.

For smaller flasks the machine is operated by hand. The hand lever *F* is raised, actuating the rods at *K* which in turn raise the pistons *H* and *I*. The weights *N* Fig. 5, hanging as the wire-rope-pulley *M* and the weights *O* fastened to lever *F* serve as counterweights and make the work easy. As the illustrations show, the lifting device is free during jolting.

For larger machines, a hydraulic lifting device is provided. Under certain conditions this machine also may be worked with a stripping device. When the lifting device is raised, the stripping plate *R* is lifted with the flask *Q* while

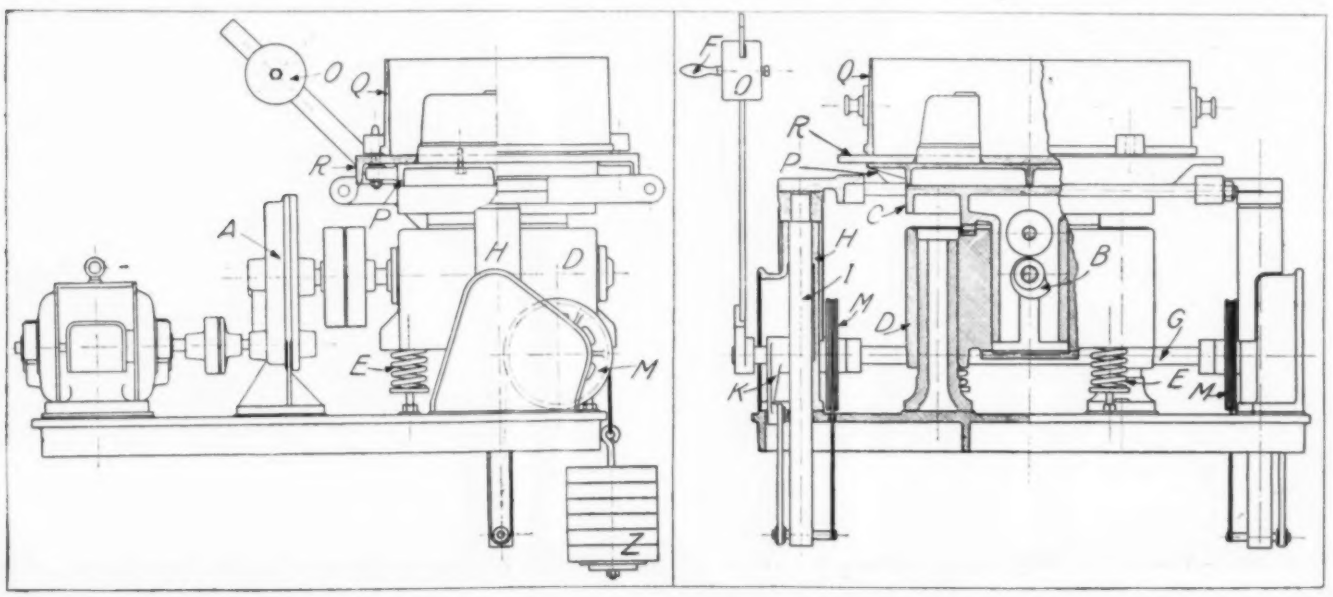


FIG. 1—SIDE VIEW OF ELECTRIC OR HAND OPERATED JAR-RAMMING MACHINE—FIG. 2—FRONT VIEW AND SECTION THROUGH HALF OF MACHINE SHOWN IN FIG. 1, SHOWING THE STRIPPING DEVICE

(*Continued from Data Sheet No. 408*)

Standardization—The most satisfactory method is to standardize against an iron of known sulphur content, preferably .08 to .11 per cent sulphur and not over 1 per cent combined carbon. Standardization should be carried out by the gravimetric method, or standard samples should be obtained from the United States bureau of standards.

Procedure—Place 3 grams of ground sample in evolution flask. Fill test tube about to level shown in Fig. 3 (or little lower) with cadmium chloride solution. Get stopper and tube ready to put in place. Add quickly 125 to 150 c.c. HCl solution under stopper and quickly put stopper in place. Allow to evolve about 5 to 10 minutes, light burner and boil 15 to 25 minutes longer. Pour cadmium solution into 350 c.c. casserole washing tube quickly with a little diluted HCl, *cool*, add about 50 c.c. conc. HCl and titrate immediately against iodine solution, using starch indicator.

Notes and Precautions—More concentrated acid should be used for materials high in combined carbon. The method given is best adapted to hypoeutectoid gray irons up to 0.15 per cent sulphur.

Cadmium chloride is to be preferred to zinc salts, KOH or NaOH, as it is more accurate and fixes the sulphur in an easily visible form. An experienced operator can often judge the amount of sulphur closely from the appearance of the precipitate.

If desired, the iodine solution can be diluted or concentrated to give an even factor, i. e., as 0.01 per cent per c.c.

It is best to make a new starch solution every day.

It is not necessary with good manipulation to add the acid through a thistle tube or funnel.

With proper manipulation this particular apparatus will never *suck back*. The separatory funnel stopcock can be used if necessary.

It is not necessary to pass hydrogen or natural gas to wash out the last traces of H_2S.

Filteration of the cadmium sulphide offers no particular advantages. Possible sulphur loss during the maceration of the filter paper is avoided when not filtering.

The acid-H_2S solution should not be allowed to stand. When titrating vigorous stirring must not be used except at the last. A layer of iodine should be kept on top of the bulk of acid-H_2S solution. It is best to add a little more of the indicator toward the end of the titration. A satisfactory end point is where the starch-iodine color is deep enough so that a stirring rod just disappears when held on the bottom of the casserole. The same operator can judge the end point very closely but there is a little difference with different operators. The ordinary blank on this method is 0.2 c.c.

The iodine solution changes somewhat so it is well to make it up in small lots and standardize it frequently. Also it is well to keep it in an opaque container to prevent its exposure to the light unnecessarily.

The foregoing method is offered as one which is accurate on hypoeutectoid gray iron and steel especially as indicating the *relative* day to day changes in a regular grade of metal. Its limit of absolute accuracy, of course, depends on the original standard.

White iron such as unannealed malleable will not give up all its sulphur like a hypoeutectoid gray iron in the evolution method.

(*Continued on Data Sheet No. 410*)

ROUTINE ANALYTICAL METHODS

(*Continued from Data Sheet No. 409*)

Duplicate results generally check within .002 per cent. The theoretical iodine factor is generally somewhat lower than factors based on gravimetric standards.

The rate of evolution has an important bearing, too fast or too slow evolution causing low results. About five bubbles should be in the tube at one time.

Alternate Method

A method affording a somewhat less arbitrary end point from the one just given, but equally if not slightly more accurate, yet requiring more manipulation, has the following modifications:

Use water guard between the evolution flask and the absorption tube. Filter off the CdS using a soft open texture paper, and place the paper in a large beaker or casserole, covering with 300 c.c. H_2O.

Rinse test tube and evolution tube with dilute HCl. Titrate with iodine to first true blue color. The end point is sharp. A blank runs about 0.1 c.c.

DETERMINATION OF SILICON

Principle—The silicon in cast iron ordinarily occurs as the element silicon in solid solution, with possibly small traces of SiO_2 as admixed slag, oxidized silicon, etc. Nitric and sulphuric acids effect solution of the iron. The nitric acid mixture oxidizes the silicon (Si) to silica (SiO_2) which, when dehydrated, is nearly insoluble in these acids and in HCl. Evaporation and treatment with HCl render the silica practically completely insoluble. The acid solution dissolves the iron and changes the silicon to silica acid (hydrated silica), which is dehydrated and made insoluble by fuming with H_2SO_4. When filtered off and ignited the silica is somewhat impure (retaining small amounts of Al_2O_3, TiO_2 and Fe_2O_3). On treatment with HF and H_2SO_4 the silica is volatilized and the impurities left, and the amount of silica is obtained by difference.

In Gray Iron

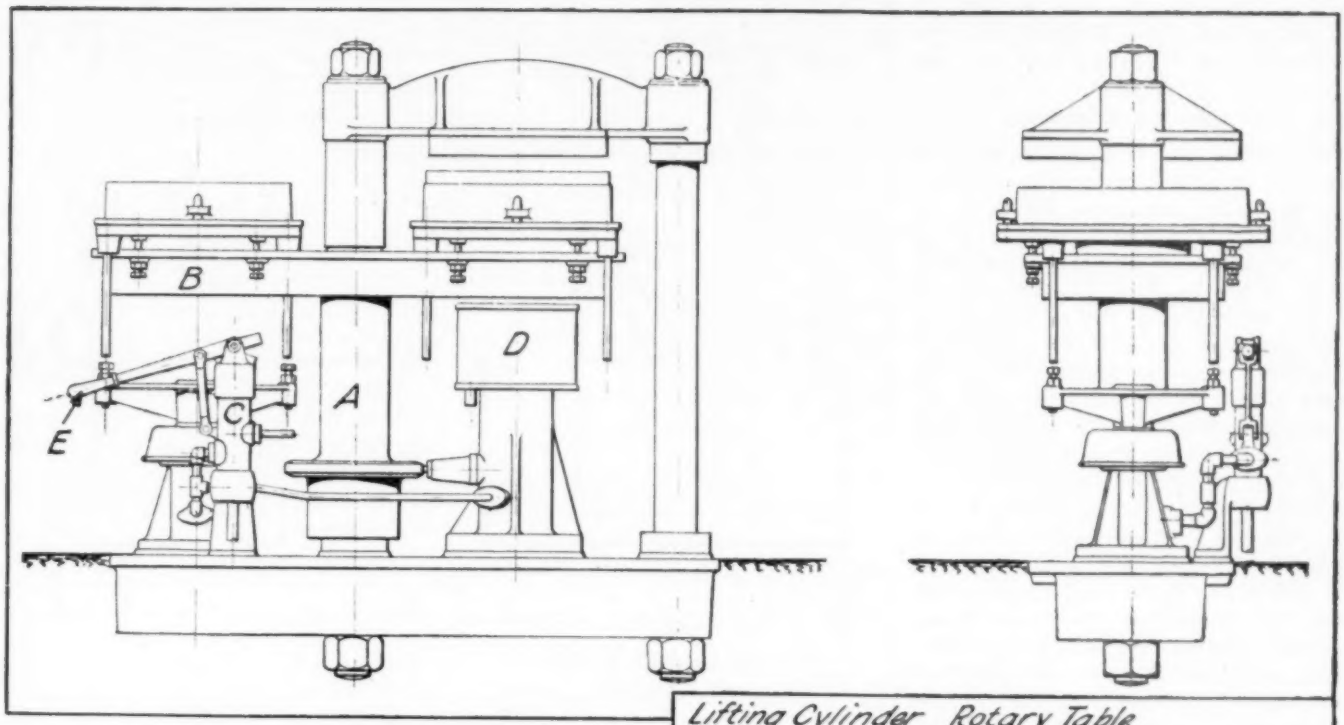
Procedure—Dissolve 1 gram of drillings in a 250 to 350 c.c. casserole with 30 c.c. silicon mixture, made by adding 150 c.c. H_2SO_4 slowly to 500 c.c. H_2O, and 500 c.c. HNO_3 to 1000 c.c. H_2O, mixing the two solutions together after they become cool. Evaporate on hot plate until white sulphuric acid fumes are driven off and a spongy mass is left. Cool casserole a little, add about 15 c.c. concentrated HCl and evaporate to dryness. Add about 5 to 10 c.c. concentrated HCl and 35 to 60 c.c. H_2O. Heat just until iron salts are dissolved. Filter (using 31 Whatman filter paper) washing with dilute HCl (2 of HCl to 10 of H_2O) and hot H_2O alternately until paper is completely free from iron. Ignite in a platinum crucible in muffle furnace. If black or gray, break up carefully with rod and reignite. Weigh crucible, add 3 or 4 c.c. HF and 1 to 3 drops concentrated H_2SO_4. Evaporate without spattering, heat to redness and reweigh.

Weight of SiO_2 × .47 = per cent silicon (Si)

(*Continued on Data Sheet 411*)

THE FOUNDRY DATA SHEET, DECEMBER 15, 1921
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.



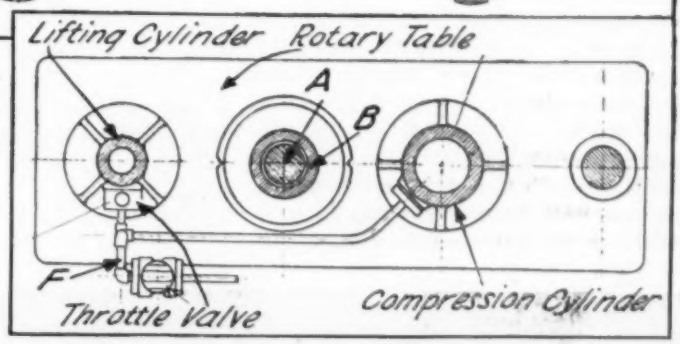


FIG. 3—ABOVE—SIDE AND END VIEW OF A ROTARY TABLE SQUEEZER MACHINE WITH SPECIAL PATTERN-DRAWING DEVICE FIG. 4—RIGHT—SECTION THROUGH THE CYLINDERS AND POSTS, SHOWING THE ARRANGEMENT FOR OPERATING THE SQUEEZER AND DRAWING MECHANISM FROM ONE HYDRAULIC VALVE

the board *P* with the patterns remains fast on the jolt table.

Figs. 3 and 4 show an hydraulically-operated, rotary-table machine also built by the Schwabische Huttenwerke, Wasseralfingen, that has some noteworthy peculiarities. The machine works with separate cylinders for pattern drawing and squeezing. Figs. 3 and 6 show the general arrangement of this machine. The rotary table *B* may be turned 180 degrees round pillar *A*. One flask is on the pattern drawing mechanism *C* while another is squeezed on the mechanism *D*. The machine is operated by one regulating valve worked by handle *E*.

Revolve the Table

As soon as a finished mold has been lifted, an empty flask is put up and the table *B* rotated 180 degrees when the mold last made comes over the pattern-drawing device and the empty flask under the squeezer is filled and pressed against the rigid head. Instead of the pattern drawing device, a stripping plate may be used. The bottom boards in both cases rest loosely upon the bolts of the underframe and may be interchanged in a short time.

Fig. 4 shows a section through the cylinders. The post around which cylinders *B* and *C* are rotated is shown in the center. The compression cylinder *D*, as well as the lifting cylinder *E* are connected with the same hydraulic line, *F*. A throttle valve inserted between the controlling valve and the lifting

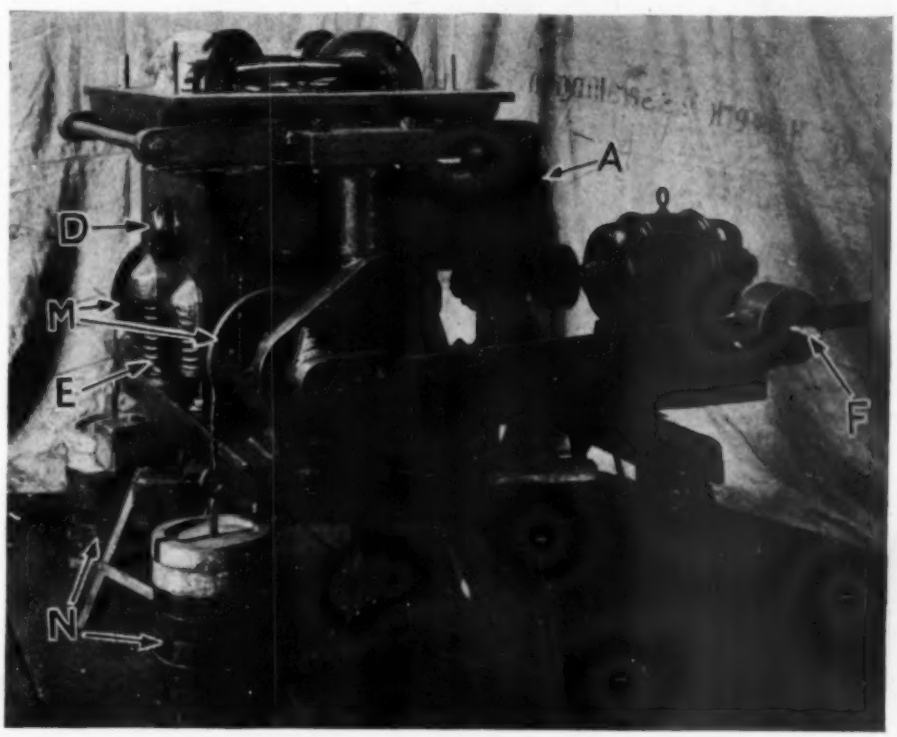


FIG. 5—ELECTRICALLY AND HAND OPERATED JAR-RAM MACHINE SHOWN IN DETAIL IN FIGS. 1 AND 2

cylinder, permits the water to flow so slowly to the lifting cylinder that a gradual lifting is secured while the sectional area of the valve is full when the lifting piston is depressed.

The efficiency of any molding machine is limited if the molders have to fill the molds and to lift the flasks by hand. This factor has been responsible for the American practice of furnishing sand to the machines automatically. In some cases the machines themselves are moved along the sand heap. A semi-automatic sand conveying system has been devised by V. Dahlmeyer for the machine described. As it may be noted from Figs. 6 and 7, sandhoppers, movable in a vertical direction between columns are provided on both sides of the machine. These hoppers may be lifted and lowered by a winch *A*, Fig. 7 in such a way that one hopper rises when the other is lowered. The lower hopper is filled from a wheelbarrow, an overhead traveller or other conveying arrangement. Removal of the finished molds from the machine is effected by a special trolley hoist *K* Fig. 7. A yoke engages trunnions on the flasks which rest lightly on the guide pins of the pattern-drawing table. The finished molds are lifted and conveyed to the pouring floor on the traveling hoist as shown in the left foreground in Fig. 6.

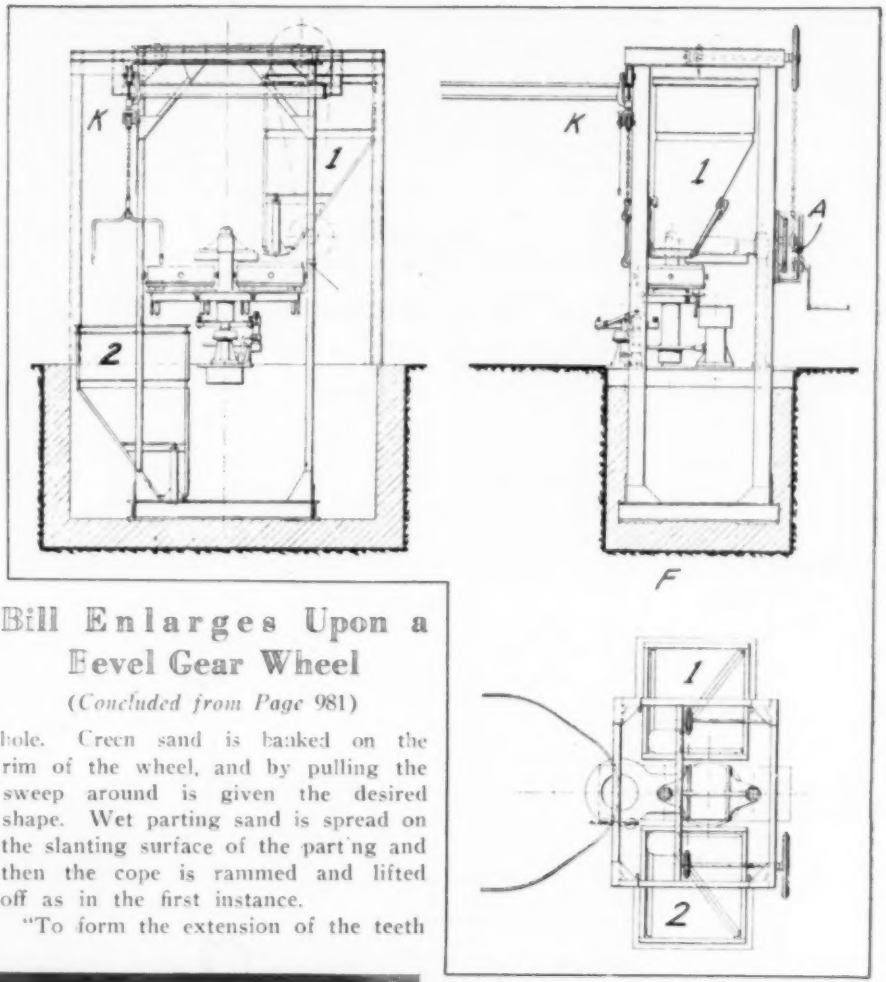


FIG. 7—SIDE, END AND TOP VIEW OF THE ROTARY-TABLE MACHINE, INDICATING THE METHOD BY WHICH THE SAND HOPPERS ARE RAISED AND LOWERED TO FACILITATE FILLING THE FLASKS—NOTE THE HOIST

Bill Enlarges Upon a Bevel Gear Wheel

(*Concluded from Page* 981)

hole. Green sand is banked on the rim of the wheel, and by pulling the sweep around is given the desired shape. Wet parting sand is spread on the slanting surface of the parting and then the cope is rammed and lifted off as in the first instance.

"To form the extension of the teeth in the drag it will be necessary to provide several teeth 9 inches long, preferably attached to a segment of pattern conforming to the rim part of the pattern. The built-up sand first is removed, care being taken that the remainder of the parting is not disturbed; then the pattern is removed, after which it is necessary only to drop the short segment into place, tuck the ends of the teeth full of facing sand and continue the operation until all the teeth have been filled."

"All very interesting me good man," I said, "but still you must admit that even a knowledge of gear molding cannot be applied to everything. For instance what use would it have been to the winsome lady Kathryn?"

"For a grown-up man," said Bill, "one who has braved the perils of matrimony with all the preliminary skirmishing that implies, you certainly ask some of the most foolish questions. You take it from me, the average young lady needs no instruction either in the methods of making wheels, or in the way of making them go around to suit herself."

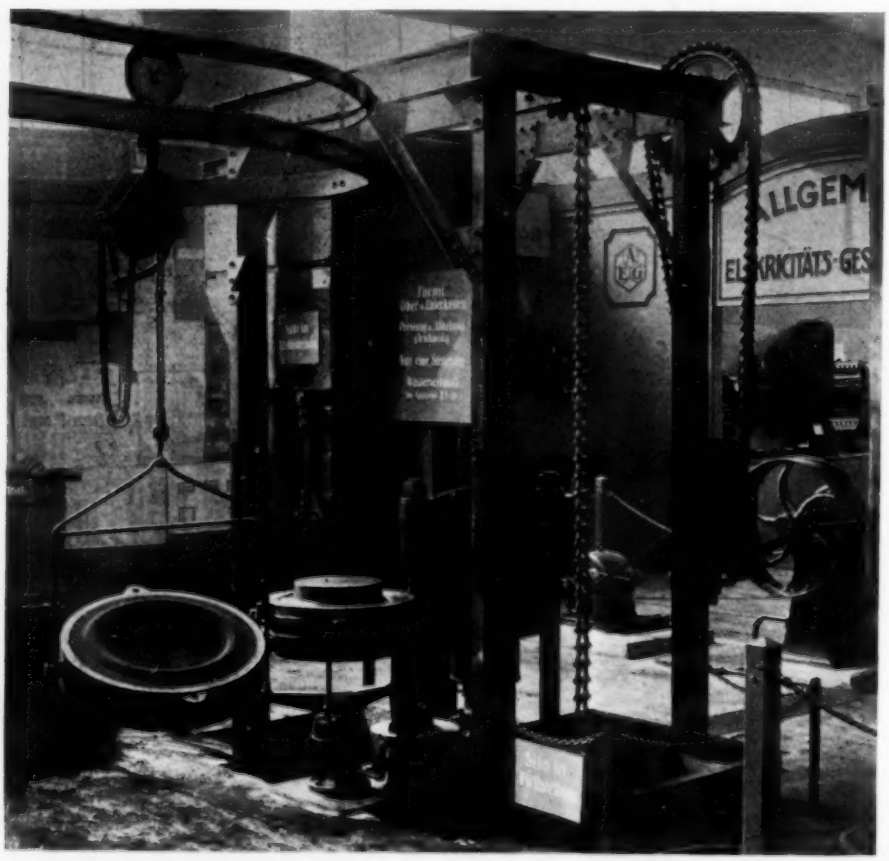


FIG. 6—THE ROTARY TABLE SQUEEZER MACHINE, SHOWING THE ARRANGEMENT OF SAND HOPPERS FOR DELIVERING SAND DIRECTLY TO THE MOLD TABLE

Open Sand Plate Molding Simplified

Cast-Iron Straight Edges and Iron Bars Relieved the Molder of the Necessity of Ramming Sand Around the Margins of the Plates from Day to Day

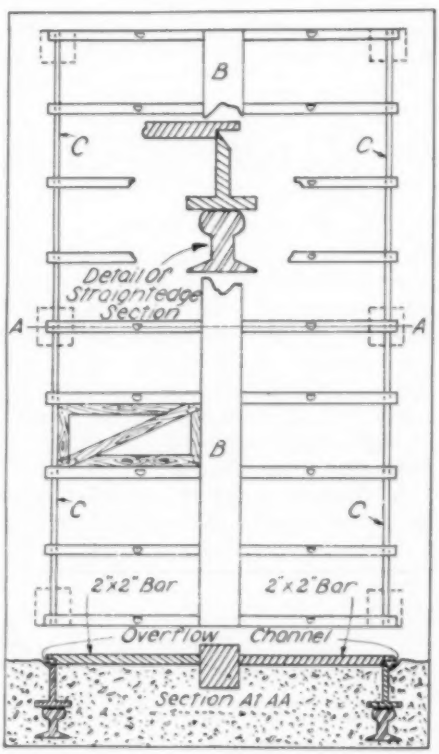
BY GEORGE BOYS

MY EXPERIENCE based on many years' observation of foundry practice in different parts of the world lends confirmation to statements made by Pat Dwyer in a recent series of articles published in THE FOUNDRY dealing with open sand molding practice. It really is surprising to note how many molders do not know how to level a bed properly, how to prepare the sand so that the iron will lie quietly on it, how to ram the sand if the casting requires long prongs or dabbers, how to arrange the handles, holes and loops on a lifting plate or dabbers and reinforcing rods on a core arbor or crab. One of the most common mistakes, especially in shops provided with hard floors is to make the sand bed too shallow and a second common mistake is to make the sand bed too hard. The result in both cases is the same, the steam generated under the molten iron cannot escape fast enough through the sand so it forces itself up through the liquid iron, patches of sand on the face of the mold are raised at the same time and the resulting casting will be covered with scabs on the lower side and with a mass of slush and slag on the upper side.

When the proper precautions are observed the open sand method of molding will produce castings that are perfectly satisfactory for many purposes. It may be adapted in many ways to meet specific conditions, a typical example being shown in the accompanying illustration.

We were offered the job of making between 150 and 200 tons of floor plates 3 feet 6 inches long, 2 feet wide and ¾-inch thick. The order specified that the plates should be flat, and of a uniform thickness, with rectangular corners and straight sides so that they would fit closely side by side. Apparently it was a good foundry job but when we learned the price the customer was prepared to pay we decided that we were better off without it although we were running quite slack at the time. However, before finally rejecting the contract I submitted a proposition to my associates which promised a margin of profit and upon further consideration we decided to accept the job and go through with it.

We prepared the rigging and fitted up two beds similar to that shown in the illustration. The straightedges were in two parts and were butted together to make a continuous bed



THE LENGTH OF THE PLATE WAS REGULATED BY THE STRAIGHTEDGES AND THE WIDTH WAS DETERMINED BY A WOODEN FRAME WHICH WAS MOVED ALONG THE BED UNTIL ALL THE DIVIDING BARS *D* WERE PLACED

in each case. Briefly described the idea was to supply a flat level sand bed on which the ends of the plates were confined by iron straightedges and the spaces between the plates were taken up by pieces of 2 x 2-inch iron bars.

The square bars *BB* first were set up end to end and leveled, then the four iron straightedges *CCCC* were set up as shown 3 feet 6 inches (shrink rule measurement) away from the center bar and with the top edge about 2 inches lower than the top edge of the center bar. The straightedges, bevel edged on the top and provided with three feet on the bottom were cast in open sand, bevel edge down. The bars *D* also were cast in open sand and were employed as shown to form the sides of the plates. A thin iron strike provided with a jog ¾-inch at the outside end and 2¾-inch at the inside end was used to form the sand bed for the bottom surface of the plates. The feet on the straightedges rested on short pieces of rails as shown in the sectional view. The rails allowed the straightedges to *creep* during the expansion and contraction incident to the pouring operation and still held them level and straight. A spirit level was tried on them occasionally to verify their accuracy, but they held their position without adjustment until the job was finished. Half a dozen iron runner boxes daubed with clay and provided with three handles were set at the ends of the plates to facilitate pouring. After the first six plates were poured the runner boxes were lifted and set on the following six molds and so on until all the plates were poured. The runner boxes then were set aside until the following day.

A boy and a helper made the plates every day. After the castings had been taken away, the sand between the straightedges and the center bar was wet down, dug up and turned over like a regular sand heap. It was then flattened and rapped down approximately the proper distance below the edges of the straightedges. With the boy kneeling on the center bar and the helper kneeling outside the straightedge the iron strickle was pulled from end to end leaving a flat bed on either side of the center bar and three quarters of an inch lower than the top edge of the straightedge.

A wooden templet or square frame was employed to locate the bars, *D*, which rested on the face of the sand bed and served as retaining walls for the sides of the plates. The high bar in the center prevented the metal slopping over from one plate to another at the inside end of the plate while

the bevel edge on the straightedge allowed the surplus metal to flow over into a shallow trench at the pouring end as soon as the plate was filled to the correct thickness. This trench is indicated on the sectional view and was designed to hold a small quantity of metal to prevent distortion of the straightedge.

In pouring the plates the man on the end of a 250-pound shank commenced slowly, filled the well of the runner box, then poured a good steady stream until the mold was almost filled at which point he slowed down and poured the last few pounds gently. The amount of iron taken in the ladle each trip was gaged by the foreman's eye. If the ladle contained a few pounds too much it flowed over the bevel edge of the straightedge and if the amount was a few pounds short the runner box was tilted and the contents of the well spilled into the mold.

These plates were all so nearly alike in thickness and weight that the average variation in weight in piles of 50 was only 11 pounds and when they were placed in position on the floor of the iron works the edges fitted together perfectly. We made a fair margin of profit on the job and incidentally cleaned up the scrap yard. This incident occurred many years ago, but I have adapted the idea many times since to other jobs. I have made numerous boiler fronts in this manner including one 11 feet square, cast in four sections in a shop in New Orleans.

The most essential factor in producing satisfactory open sand castings is to pour the iron *jumping hot*. It does not matter how carefully the mold has been prepared, if the iron is not limpid and exceedingly fluid it will be impossible to gage the thickness of the casting with any degree of accuracy and the upper edges will be rounded instead of square.

In a modernly equipped foundry many things that formerly were disposed of in accordance with the judgment and trained faculties of the foreman, now are regulated mechanically. For instance if the open sand plates shown in the illustration were made in a modern foundry they would be laid out in a straight line under a monorail hoist. The small ladle for pouring the plates would be placed on a scale and filled with iron from a reservoir ladle until it registered the exact amount necessary to fill the mold. In this manner and provided the face of the sand bed was uniform, every plate would be exactly alike in weight and thickness.

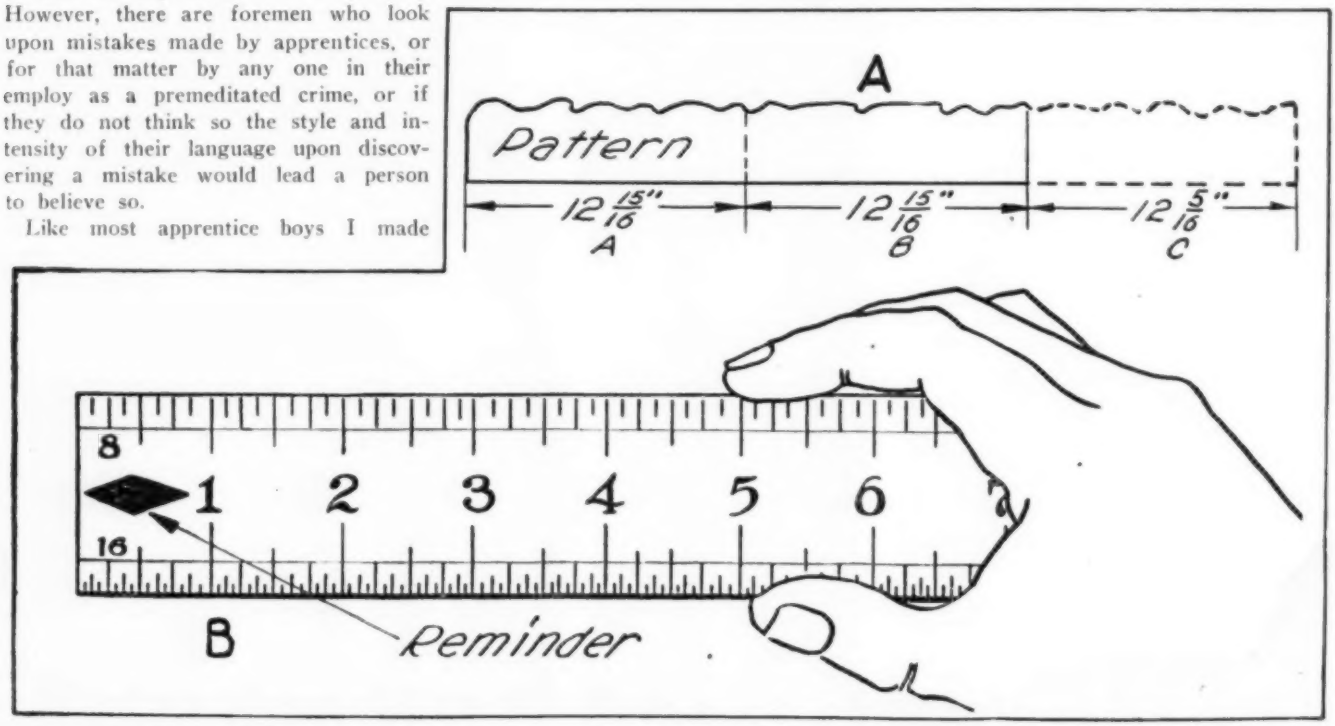
Teaching Apprentices To Avoid Mistakes

BY M. E. DUGGAN

IT IS not necessary to say that all apprentice boys make mistakes in their work while learning their trade. Every one is aware of the fact and it generally is recognized as a perfectly ordinary circumstance. Many foremen regard it in this light and take pains to point out to the boy the why and the wherefor leading up to the mistake so that he may avoid it in the future. However, there are foremen who look upon mistakes made by apprentices, or for that matter by any one in their employ as a premeditated crime, or if they do not think so the style and intensity of their language upon discovering a mistake would lead a person to believe so.

Like most apprentice boys I made many mistakes in the construction of my patterns. I did not make these mistakes through choice, or because I was careless or indifferent about my work. I simply did not know how the job should be made and had to blunder through it without either coaching or instruction from the boss.

A frequent cause of mistakes may be traced to the difficulty of adding two or more dimensions together, especially when each of the dimensions is made up of a whole number and a fraction. An example will make this clear. An apprentice on being asked what was the sum of the first two dimensions shown at *A* in the illustration replied quickly: 24⅞ inches. He followed the method common among pattern makers of adding the whole



METHOD OF MARKING SHRINK RULE TO SAVE TIME AND PREVENT MISTAKES INCIDENT TO READING WRONG SIDE AT *A*, AN EASY METHOD OF ADDING FRACTIONS

numbers as one group and the fractional parts as another and neglected to add the whole number which had resulted by adding the fractions. The following method is much superior.

Instead of taking the two vulgar fractions $12\frac{1}{2}$ plus $12\frac{1}{2}$ and adding them, I take the next following whole number, in this case 13. Now 13 plus 13 will make 26; and 26 minus $\frac{1}{8}$ leaves $25\frac{7}{8}$. If it is necessary to include a third dimension as *C*, the sum would be 13 plus 13 plus 13 equals 39. From this it will be necessary to subtract the sum of *A*, *B* and *C*, or $\frac{1}{16}$ plus $\frac{1}{16}$ plus $\frac{1}{12}$ making a total of $\frac{11}{48}$, which being taken from 39 leaves $38\frac{37}{48}$.

A shrink rule graduated in 8ths, 10ths, 12ths and 16ths is another prolific source of mistakes among apprentices or for that matter, careless journeymen. Most of the risk is obviated by placing a distinctive mark like the one shown in the illustration, *B*, on the one inch end of the side which is laid out to normal scale. The mark consists of a piece of brown drawing paper, black varnished and pasted on the rule as shown. It is easily apparent the moment the rule is picked up and the man is not obliged to turn the rule end for end three or four times. Further, it serves to prevent a man from using the wrong graduations on the scale.

Finds Use for Old Broken Phonograph Records

By W. B. Kresge

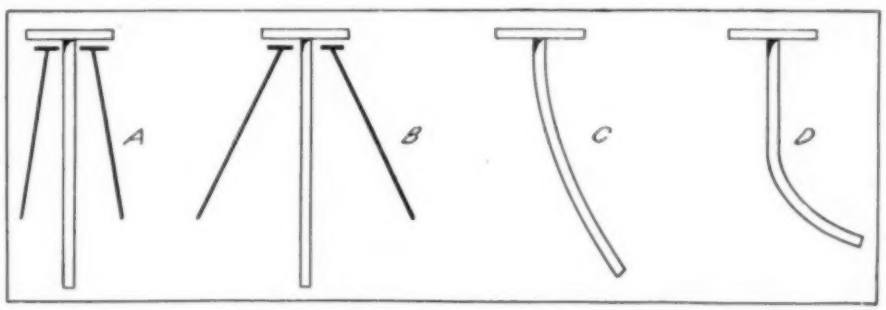
Did you know that discarded phonograph records find ready application in the pattern shop? They can be used to advantage in repairing old wood patterns, filling crevices, holes or building on patterns. They are used in the manner usually employed when burning in hard shellac with the aid of an alcohol lamp and a warm putty knife. Heat the material over a lamp and force it into place with a warm knife. It cools quickly and when it is hard may be pared to the required shape. Finished with sand paper it is ready to be shellaced with the remainder of the pattern, giving a smooth joint.

Nails Sometimes Set to Support Chaplets

By Thomas Nelson

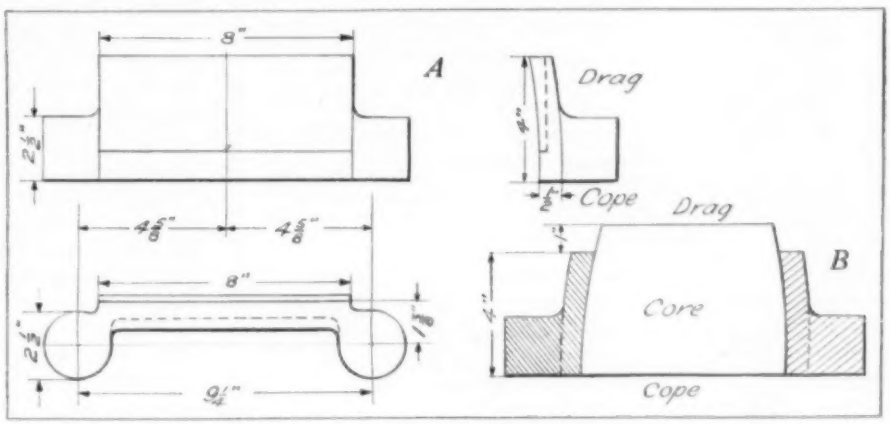
The usual practice in securing stem chaplets in a mold is to drive the point of the drag chaplet into the bottom or into a block of wood rammed in the drag for that purpose. The cope chaplet is held down by a projection on one of the bars, by a strip of iron spanning the cope and held by clamps at each end, or by a weight placed on top of the cope. On small cores where the weight of the core or the upward pressure is not a serious factor, it is not uncommon simply to drive the chaplet into the sand with two or more nails braced under it for extra support.

Where the metal thickness around the chaplet and nails is ¾-inch or more that method may be satisfactory since the metal probably will be solid. However many castings have been lost due to the metal chilling around the cluster of cold iron nails. Also many castings have been lost because the nails were not set at a sufficient angle properly to support the core. This is illustrated in *A* and *B* showing respectively the wrong and right method of placing nail supports under a chaplet.



THE NAILS AT *A* ARE SET TOO CLOSE TO THE CHAPLET—THE CHAPLET SHOULD BE BENT AS AT *D*

Instead of placing a cluster of nails around a chaplet I have found that a single chaplet with a rather sharp bend near one end will render more satisfactory service. In driving it into position it is started far enough from the perpendicular to allow for the curve with which it will go home. A continuous curve from end to end of the chaplet will not do. It will yield under the pressure just as readily as if it were straight. All that is required is a sharp bend close to the end. Figs. *C* and *D* in the accompanying illustration illustrate this point. The chaplet *D* is the correct form.



THE ORIGINAL METHOD IS SHOWN AT *A* AND THE IMPROVED METHOD AT *B*

Change in Pattern Design Raises Production

By C. J. Morrette

Apparently many patterns are constructed with the single object in view of producing something that will draw out of the sand easily. Primarily a pattern should be made in a manner to facilitate production in the foundry and that this most essential factor frequently is overlooked probably is due to the fact that the majority of pattern makers have not had sufficient foundry experience. The pattern shown in the accompanying illustration is a fair example of such a job.

The original pattern was made with a loose piece as indicated at *A* and was the cause of considerable unnecessary work in the foundry in making up the molds and limited production to between 75 and 100 molds a day. Eventually a second pattern was made without any loose piece, the loose piece in the first pattern was attached permanently in place and a core print was fastened between the two patterns as shown at *B*. After the change was made the molder drew both patterns at one operation and as a result produced a mold for two castings practically in the same time formerly used in making one. The pattern was molded on end as shown at *B* so that the curved face was free from slag.

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Deflation, Blowout or Puncture

DEFLATION is the act of relieving pressure or inflation by gradual means. The process as applied to business and industry in the period which, we hope, is drawing to a close, has been effective in many ways. Some have encountered it voluntarily, others under remonstrance and the greater majority have acted only through the application of external force of circumstances. In some instances deflation has taken place like a slow leak in a tire, gradually, reluctantly and with a hissing sound from the deflated one. In others the reaction may be likened to a blowout with its accompanying noise and destructive effect. A new phase in the problem has arisen in the foundry industry. Some, unable to await the natural trend of circumstances and misinterpreting deflation to mean an entire flattening with perhaps a slight tendency toward a condition of vacuum, have thrust an exceedingly sharp knife into castings prices.

Recently some miscellaneous gray iron castings for automotive service were contracted in the Middle West for 6.25 cents a pound. Again, a varied lot of machinery castings embracing some light and intricate work together with blocky frame castings were placed at 4.00 cents a pound. Curious inquiry elicited the information that the foundry accepting the latter job had figured metal and labor and tossed profit and overhead into the discard. In the former case, the work was taken as fill-in to provide full-time operation, while the overhead was assessed against other regular work of the foundry.

Another instance is furnished of an eastern foundry, which under slackening business paused to figure if it should fill the shop with work taken at what it estimated to be cost, or whether it was better to close down. In this case, it was said, that the loss in overhead when the plant was idle was greater than the loss when in operation with no profit. Consequently this shop is furnishing castings to its customers on an altruistic basis, namely, profit is unselfishly omitted.

Obviously, these conditions can never react to the advantage of the industry or any manufacturer of castings. As is pointed out in an article in this issue on the importance of costs, by Robert E. Belt, many users of castings trade upon the assumed ignorance of the average foundryman regarding his actual costs in producing castings. Admitting that a certain number have not the means nor ability to determine their production costs, the menace of their competition in fixing prices for castings is obvious. When the effect of the prices made by those who do not know their costs is augmented by figures which disregard all costs and eliminate profit, it is evident that the chances for the average foundryman to make any money from his shop are an infinitesimal minus. Deflation truly has been accomplished in many lines. It may be said to have reached its final stages in the foundry industry, where castings prices in general approach the prewar level. The period at hand is the most critical of the entire cycle, and only the most careful consideration of costs accompanied by a self-respecting insistance upon a reasonable profit will serve to carry the industry through to brighter times ahead.

Trade Outlook in the Foundry Industry

DECEMBER, always a quiet month in the foundry industry, shows no indication of violating precedent. Slight improvements are noted in some instances, incident to railway purchases and the phenomenal demand in heating and sanitary lines. Business conditions in general indicate an attitude of hopeful expectation. Commodity prices with a few exceptions have ceased to decline and have in special instances improved from a low level reached during the preceding months. Declines in unemployment totals, with crystalizing efforts toward lower transportation rates are factors in optimism as expressed in financial reviews.

Auto Trade Unforeseen

It is probable that the current year's output of passenger automobiles will not be as far behind 1920, as was predicted during the summer and fall. Sales of the leading automobile manufacturers, excluding Ford, were 188,000 vehicles for the third quarter, a total which is 71 per cent of the sales for the same quarter of 1920. At none of the periods during the year have the total sales matched the respective totals of 1920. It is expected that the 1921 total, exclusive of Fords, will be 558,000 cars or about 57 per cent of the number sold last year. The estimated Ford output for the year is 953,000 vehicles. The showing of the entire industry is surprising in view of the prognostications made some months back. Automotive foundries are not active at the present time. Contracts for castings are placed on the hand-to-mouth basis, and few of the larger shops devoted to this class of work are working more than three or four days a week.

Prices of Raw Material for Foundry Use

CORRECTED TO DEC. 8

Iron		Scrap	
No. 2 Foundry, Valley	$22.00 to 24.00	Heavy melting steel, valley	$14.00 to 14.25
No. 2 Southern, Birmingham	17.50 to 18.00	Heavy melting steel, Pitts.	14.00 to 14.50
No. 2 Foundry, Chicago	20.00 to 21.00	Heavy melting steel, Chicago	11.50 to 12.00
No. 2 Foundry, Philadelphia	21.75 to 22.40	Stove plate, Chicago	14.00 to 14.50
No. 2 Foundry, Buffalo	19.50 to 20.00	No. 1 cast, Chicago	14.50 to 15.00
Basic, Valley	18.75 to 19.00	No. 1 cast, Philadelphia	17.00 to 18.00
Basic, Buffalo	19.00 to 20.00	No. 1 cast, Birmingham	16.00 to 17.00
Malleable, Chicago	20.00 to 21.00	No. 1 cast, Buffalo	17.00 to 18.00
Malleable, Buffalo	19.00	Car wheels, iron, Pittsburgh	15.00 to 15.50
Coke		Car wheels, iron, Chicago	16.00 to 16.50
Connellsville foundry coke	$3.75 to 4.25	Railroad malleable, Chicago	13.50 to 14.00
Wise county foundry coke	5.50 to 5.75	Agricultural mal., Chicago	13.50 to 14.00
		Railroad malleable, Buffalo	13.00 to 14.00

Stocks Are Low

Pig iron purchases during the month have been light. Foundries are carrying light stocks through a desire to enter the inventory period with small holdings. The same condition governs in the storage of coal. The department of commerce reports coal stocks as of Nov. 1 compiled from statistics gathered jointly by the department and the geological survey, at 47,400,000 tons or approximately 43 days supply. This compares with a coal reserve as high as 63,000,000 tons in years past. Significant of the present day tendency, is the fact that the railroads have only 29 days supply and the steel plants and the coke industry only 42 days reserve. The figures given represent averages and many of the individual industries show far less. Few foundries are maintaining more than a few weeks supply of coke. Castings requirements incident to recent purchase of freight cars are filtering through to the foundries, and malleable, gray iron and steel shops are benefitting to a slight degree. Repair orders continue on about the same level. The end of the year shows cast iron pipe demand much lighter, although the volume of business on the books finds pipe foundries entering the new year on a satisfactory basis. Municipalities usually begin to state their requirements during January. In the East, textile machinery manufacture continues to supply a steady demand for casting, while throughout the many centers an unusual demand for printing presses has brought considerable business to specialty and jobbing shops supplying this branch of machinery manufacture.

Iron Output Increases

November statistics, as compiled by *The Iron Trade Review*, show the past month to have had the highest pig iron production since March. The total output of pig iron for November was 1,414,958 tons, an increase of 180,508 tons over the October total of 1,234,450 tons. Twenty-five additional furnaces were blown in bringing the active total on Nov. 30 to 120. The gain in the number of active stacks was within one of the total gain shown in September and October together. Merchant pig iron output also showed a gain. Nine merchant stacks were, blown in, while 16 nonmerchant furnaces became active. The total production of merchant iron for the month just past was 304,535 tons, a gain of 85,545 tons over the October output of 218,990 tons. On a daily average basis, the November figure was 10,151 tons as compared with 7064 tons in October, a gain of 3087 tons or 43.7 per cent. Pig iron orders during the past month and the first weeks of December have been for small tonnages, and unusual prices have been forthcoming, particularly on southern iron and in some cases the silicon differential has been practically disregarded in the quotations offered. Conditions in the implement manufacturing lines continue unimproved. Cuts in prices on farm machinery, tractors and trucks by some of the larger interests were reported only a few months ago. The first week in December witnessed another reduction, amounting in some cases to as much as 30 to 40 per cent.

Nonferrous Prices

Nonferrous prices, based on New York quotations in the *Daily Metal Trade* of Dec. 8, follow: Casting copper, 13.00c to 13.25c; electrolytic copper, 13.62½c;; lead, 4.70c to 4.75c; Straits tin, 31.25c to 31.37½c; antimony, 4.50c to 4.60c; aluminum, No. 12 alloy, producers' price, 19.00c to 19.20c and open market, 14.00c to 14.50c. Zinc is 4.85c to 4.87½c, E. St. Louis. The daily average prices of nonferrous metals for November follow:

OCTOBER AVERAGE PRICES

(New York Quotations)

Casting Copper	Electro. Copper	Lead	Tin Straits	Antimony	Aluminum 98.99	Zinc St. Louis
12.58	13.31	4.69	28.99	4.62	17.50	4.68

Personal

Otto Agricola, president of the Agricola Pipe Co., Gadsden, Ala., has been elected to the presidency of the Gadsden chamber of commerce.

Charles Wilson has been promoted to assistant superintendent of the Enterprise Foundry Co., Auburn, N. Y. He has been with the company four years.

Edward Heldt, for 20 years connected with various Wisconsin and Minnesota shops, has been made general manager of the Lincoln Foundry Co., recently organized at Merrill, Wis.

Elmer S. Whittier, son of Albert E. Whittier, owner of the Cooper Oven Thermometer Co., Pequabuck, Conn., has leased a factory in Terryville, Conn., and will make welding chemicals and metal coloring.

A. D. Keene, electric furnace engineer, Schenectady, N. Y., is now connected with the Pittsburgh Electric Furnace Corp. as engineer on electric furnace designs and applications in the steel and metal industries. He has moved his residence from Schenectady to Pittsburgh.

M. Z. Fox, for a number of years connected with the John Hill Foundry Supply Co., Cincinnati, has been appointed Chicago sales manager for the Hill & Griffith Co. with which the previously mentioned firm recently was consolidated. The Chicago offices of the Hill & Griffith Co. are at 3900 S. Union avenue.

Capt. G. G. Gerke, supervisor of patterns and foundry representative of the Norton Co., Worcester, Mass., has been appointed to a position in the office of the construction quartermaster of the United States organized reserves in Washington. He was a casual replacement officer with the engineers and quartermaster corps during the war.

Lawrence Johnson, Collinsville, Conn., sailed from New York Nov. 19 for Jamshedpur, India, where he is under three years contract as works manager for the Agriculturals Implements, Ltd., Bombay. He has been identified with Charles W. Perin, a New York consulting engineer for the Bombay company during the summer in drawing plans and buying machinery for the Jamshedpur plant, which is under construction.

N. P. Farrar has been placed in charge of the Pittsburgh territory for the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., with headquarters in the Union Arcade building, Pittsburgh. He succeeds W. C. Minear who is resigning from the Shepard company after an affiliation of about 12 years. Mr. Farrar has been identified with the Shepard interests for about 15 years and for the past three years has been in charge of that company's Baltimore office, territory in connection with which extends over 13 southern states. Prior to that time he was connected with its Philadelphia office for about eight years.

Michigan Foundrymen's Association Meets

The Michigan Foundrymen's association held a general meeting at Kalamazoo, Tuesday Dec. 13. The officers of the association are: President, J. Edgar Lee, Challenge Machinery Co., Grand Haven; treasurer, E. N. Turner, Manistee Iron Works, Manistee; secretary, A. W. Blodgett, Kelsey building, Grand Rapids.

Addresses Steel Treaters

Prof. H. F. Moore, director of the department of materials and engineering at the University of Illinois, and a member of the National Research council addressed the regular monthly meeting of the Pittsburgh chapter of the American Society for Steel Treating, Tuesday evening, Dec. 6. Professor Moore spoke on the fatigue or progressive failure of metals under repeated stresses.

Cleveland Founders Join State Association

The members of the Founders' Association of Cleveland in a meeting held Nov. 28 unanimously voted to disband and many accepted the invitation of the Ohio State Foundrymen to unite with that association. The objects of the Ohio State Foundrymen's association are co-operation on all matters pertaining to the foundry industry in Ohio, furnishing statistics and advice to its members on all matters of interest. The association also advocates a uniform cost system. By affiliating with the state association instead of maintaining the local organization it is thought the foundrymen of Cleveland will receive greater benefit.

Office Managers Hold a Convention

The second annual convention of the National Association of Office Managers was held in Buffalo, Oct. 6 to 8. Among the topics discussed were standardization of work, scientific personnel control, and economy in administration. A. A. Keiser, National Cash Register Co., Dayton, O., was elected president for the ensuing year.

Steel Treaters Arrange for Annual Meeting

Detroit has been selected as the 1922 meeting place for the fourth annual convention and exhibition of the American Society for Steel Treating, according to an announcement by W. H. Eisenman, national secretary, 4600 Prospect avenue, Cleveland. The date of the meeting is Sept. 25 to 30. Detroit is a central point as far as the membership of the society is concerned and is a large heat treating center because of the large automobile manufacturing industry there.

Two sectional meetings have also been arranged, the first to be known as the Winter meeting, is to be held in New York in January or February and the second to be known as the Spring meeting, is to be held in Pittsburgh in May. Definite dates have not been set. The new arrangement is part of an expansion program of the society which is rapidly increasing its membership and activity.

Hold Joint Meeting

A joint meeting of the American Society of Safety Engineers and the metropolitan section of the American Welding society will be held Tuesday evening, Dec. 20, at the Engineers societies building, New York. Safety developments in oxyacetylene and oxyhydrogen cutting and welding will be discussed. F. J. Napolitan, of the research laboratory of Davis-Bournonville Co., Brownsville, N. J., will discuss safety engineering in welding and cutting.

Obituary

Albert Garran Noyes of the Noyes & Nutter Mfg. Co., Bangor, Me., builder of stoves and ranges, died at his home in that city, Nov. 29, after a brief illness, aged 64 years. He was the last of a famous family of stove founders and metal workers, whose business was established in Bangor prior to the civil war.

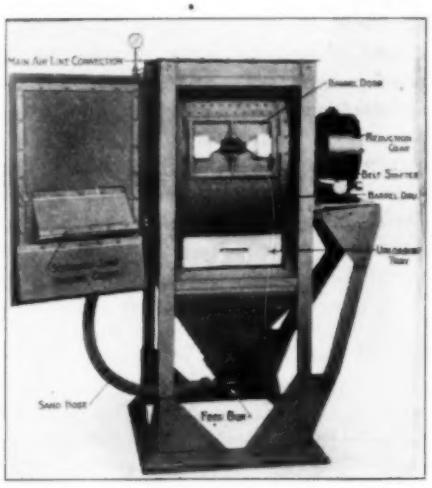
Harry D. Hammond, aged 51 years, sales agent at Indianapolis for the National Malleable Castings Co., of Cleveland, died Nov. 22 at Boston where he had gone to consult a physican. Mr. Hammond became affiliated with the National Malleable Castings Co. in 1903 and during the entire period of his connection with the company was located at Indianapolis.

Thomas Smyth Fauntleroy, president of the Moline Malleable Iron Co., St. Charles, Ill., died Nov. 9 at the Presbyterian hospital in Chicago. He was

77 years old, had been president of the Moline Malleable Iron Co. since 1905, and secretary and treasurer of the Ewart Mfg. Co. for 26 years previous. He had lived in Chicago and northern Illinois since 1861 and all his business activities had been in this section. He was a lover of athletics and organized numerous baseball and football teams after the civil war, being a factor in establishing the first professional baseball club in Chicago. He was an organizer of the Onwentsia club and first chairman of the sports committee, being largely instrumental in making golf popular.

Sand Blast Unit for Small Casting Plants

To meet the demand of the small brass foundries and other industries which do not handle a sufficient volume of castings to warrant the installation of comparatively expensive sand blast devices the Pangborn Corp., Hagerstown, Md., has developed the unit shown in the accompanying illustration. It occupies a floor space of 2 feet 7 inches by 3 feet 6 inches and stands 5 feet 6 inches high. It is of the suction type, entirely self-contained and requires neither ele-



THIS SMALL SELF-CONTAINED SAND BLASTING DEVICE IS PROVIDED WITH A BARREL 24 INCHES IN DIAMETER BY 16 INCHES LONG

vator nor conveyor. It is stated that it operates with air volume as low as 47 cubic feet a minute at 80 pounds pressure and with 32 pounds at 50 pounds pressure and with a correspondingly less amount at lower pressures.

The sheet metal, dust-tight cabinet or housing on a structural steel frame terminates in the bottom in a hopper to receive the abrasive and is equipped with a feed box supplying a hose which conveys the sand to the nozzle. The barrel drum 24 inches diameter by 16 inches long, constructed of perforated sheet metal, is mounted at one end on a shaft supported in large bearings. The driving mechanism comprises a tight and loose pulley with belt shifter, a worm and reduction gear which transmits energy to the shaft supporting the drum. The entire driving mechanism is contained in a cast iron housing integral with the structural frame and outside the barrel housing.

An opening is provided at the opposite end for the nozzle which is mounted on a swinging bracket. Dust tight doors close the barrel housing and the nozzle opening. The interior of the drum is fitted with baffles which turn the load as it rotates slowly and in this manner brings all pieces and all faces in contact with the stream of abrasive. The spent sand drops through the perforations in the drum, through a screen-bottom tote box and finally into the hopper for re-use. The tote box receives the load when the barrel is dumped. A door, extending the full length of the drum in the front of the cabinet, is held in place with a double spring latch. An opening is provided in the top of the cabinet by which, if necessary, the device can be attached to an exhaust system.

Georgia's Foundry Output Increased in 1920

Products manufactured by foundries and machine shops in Georgia during 1920 reached an aggregate value of $33,480,955.56, according to a recent report of the Georgia department of commerce.

Purchases Control of the Grindle Company

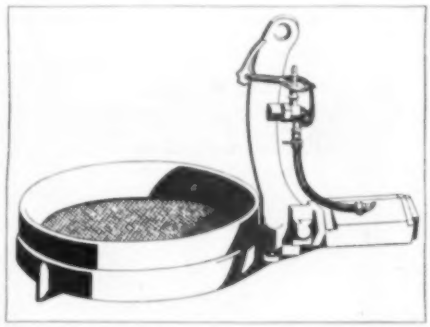
The Whiting Corp., Harvey, Ill., has purchased a controlling interest in the Grindle Fuel Equipment Co., manufacturer of complete powdered coal plants for use in connection with malleable furnaces, annealing ovens, steam boilers, billet heating, and various other types of furnaces. The Grindle Fuel Equipment Co. has moved its offices to Harvey, Ill., and will continue its business under the same name. The Whiting Corp. will manufacture all Grindle equipment.

The following officers have been elected by the Grindle company: President, B. H. Whiting; secretary and treasurer, T. S. Hammond; vice president and general manager, A. J. Grindle.

The melting point of pure zirconia, ZrO_2, is given as 2950 degrees Cent. in a bulletin of the bureau of mines, while that of pure magnesia is said to be 2800 degrees Cent.

Air Vibrator Adapted to Operate Riddle

The Malleable Iron Fittings Co., Branford, Conn., recently has developed and placed on the market a device in which another one of their products,—an air vibrator,—is adapted in such a manner that it may be utilized for riddling sand. It will be noted in the accompanying illustration that the vibrator is attached



THE VIBRATOR STRIKING 1800 BLOWS A MINUTE SHAKES SAND THROUGH THE RIDDLE

to the lower part of the frame supporting the riddle and helps to counter balance the load when the riddle is full of sand.

Among the distinctive and advantageous features claimed for this riddle are that it may be hung from any convenient point on a track, on a wall, a projecting arm or post, over a bench, or machine, or directly over the sand heap. The riddle is not fastened permanently in the frame, but may be lifted out readily for cleaning or for renewal. The weight is so distributed that it gradually tilts as the sand goes through, thus segregating all refuse and coarse material to the back. The yoke on the bottom is designed to fit snugly around a standard 20-inch riddle.

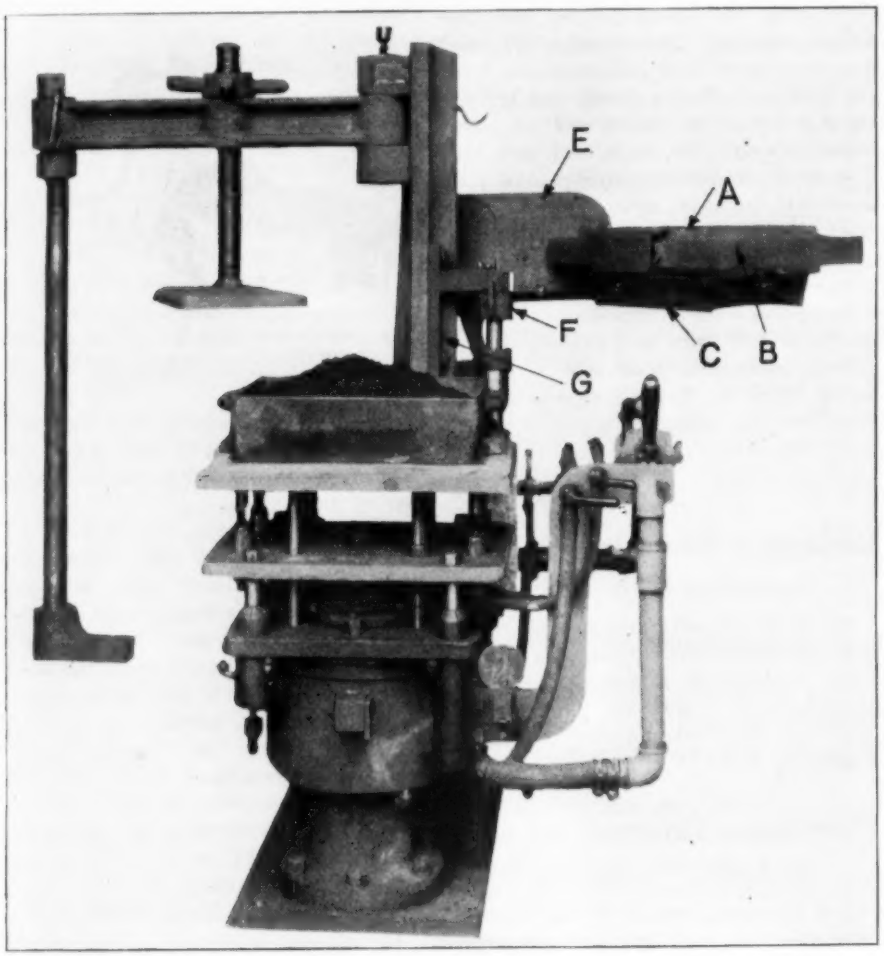
The vibrator is operated by compressed air and it is claimed this type of machine produces 1800 vibrations a minute, or sufficiently to shake sand through the screen as fast as a man can shovel it in.

Develops New Electric Foundry Riddle

The electrically operated riddle shown in the illustration on page 994, recently has been developed and placed on the market by the Automatic Riddle Co., 11412 Ohlman Avenue, Cleveland. In the illustration it is shown bolted to the column of a molding machine, but it is stated that it may be adapted and applied to any position in a foundry where it is necessary to riddle the sand. For instance, where no machines are employed, it may be attached to the wall or a post over a bench. It is provided with an automatic starting and stopping switch which throws the

riddle into action when it is pulled over the flask and shuts off the power the instant the riddle is pulled back.

The apparatus comprises, in addition to the motive gear concealed under the dust hood *E*, a bracket *G* which may be bolted to any suitable support; a yoke *F* swinging on a pivoted bolt; the riddle itself *A*; the frame *B* in which it is supported and operates; and the shutters *C*, which may be deflected to direct the sand into various sized flasks without decreasing the capacity of the riddle.



PULLING THE RIDDLE OVER THE FLASK AUTOMATICALLY STARTS THE MOTOR WHICH ALSO STOPS AUTOMATICALLY THE INSTANT THE RIDDLE IS PULLED AWAY

The motive power consists of a ¼-horsepower motor which may be connected to any electric light socket. Motors are supplied to meet conditions either on direct or alternating current. The armature shaft of the motor is provided with a cut pinion meshing with a small cut gear mounted on a second shaft and terminating at the outer end in a brake drum and crank pin. A connecting rod, working in a pair of upright guides at one end, is attached to the riddle frame and by its reciprocating motion pushes the frame back and forth. The distance between the ends of the blocks is less than the width of the crosshead in which it moves and thus produces a shock at the end of each stroke which prevents the sand from adhering to the wire screen in the bottom of the rectangular hopper.

When the operator grasps the riddle by the handle provided for that purpose and moves it over the flask, the brake is removed by a cam on the end of a lever and at the same time current enters the motor through a suitable switch. Pulling the riddle away from over the flask automatically releases the switch and applies the brake and thus prevents sand from being shaken through the riddle except when it is in position over the flask.

The weight of the riddle *A* is supported by a ball bearing roller on each side, operating in suitable slots in the frame *B*. The frame is bolted to a lug projecting above the table supporting the motive apparatus. The connecting rod moves through a suitable aperature in the end of the frame. The sheet iron shutters *C* may be adjusted to deflect the sand over any size flask. Suitable adjustable guides also are provided on the table of the molding machine to center the flask properly to receive the riddled sand.

Molds Should Not Be Sprayed with Kerosene

By C. E. Lyall

Spraying molds with kerosene is practiced by some molders to secure beneficial results, but the harm done by this procedure is greater than the benefits derived. Oil and water will not mix, so when oil is sprayed on a green-sand mold it will not penetrate the sand but remains near the surface. If a trowel is placed on the face of a mold where oil has been poured a loose spot can be detected. When the hot metal flows over this spot the sand will be cut and caught in the flowing metal.

If a mold is dried by burning oil poured on it and the face of the mold is blown with an air hose after it is supposed to be dry the slicked blackening will peal off. So, if the mold will not stand being blown on without pealing it will not withstand the hot metal running over its surface. The graphite washed off by the metal will form dirt holes in the casting; in some cases even being carried into the inner portions of the casting.

Again, if too much oil is added to the mold there is danger of an explosion. At one time I was in a foundry and noticed a molder pouring kerosene over a green-sand core. He said it would keep the sand from sticking to the casting. That day when the mold containing this core was poured it blew up as soon as the hot metal came into contact with the vapor of the kerosene.

Start Construction of Jobbing Foundry

Foundations are being put in at Cadillac, Mich., for a malleable foundry by a new company composed of R. J. Teetor, of Muskegon, C. T. Mitchell, W. L. Saunders and J. C. Ford, of Cadillac. The foundry is to be in operation about July 1. The plant has been laid out to utilize modern methods of production, transportation and material handling and will be of brick and steel. The foundry building will have a Pond truss roof and will be equipped with crane service for charging. The annealing building will have crane service throughout its length and will also contain the sand blast, grinding, cleaning and shipping departments. The foundry will produce malleable castings entirely from charcoal iron for automotive, railroad and general uses. Frank D. Chase, Inc., Chicago, is architect and engineer.

Recurrent Inquiry Grows Stronger

Purchases of Flasks and Light Equipment Together With Interest in Molding Machines and Cranes Follow Slight Improvement in Foundry Operating Conditions

WHILE holiday stagnation holds the foundry equipment market and little actual buying is reported, the volume of inquiry, representing the aggregate of many individual requirements is increasing. Foreign purchases continue to furnish business, particularly to electric furnace manufacturers. K. V. Dhengle & Sons, Victoria Gardens, Buculla, Bombay, India are inquiring for materials and equipment for a modern bedstead factory, including foundry sundries and particularly stock and chill molding frames.

Activity Noted in Pittsburgh District

SALES of foundry equipment show but little improvement, although purchases of supplies and small equipment such as is constantly needed in foundry operation are more or less steady. One recent purchaser of supplies is the Rosedale Foundry Co., Northside, Pittsburgh, which is reported to be running full, producing rolls for sheet and tin plate mills, stoker castings, etc. Roll foundries generally are going well and the National Roll & Foundry Co., Avonmore, Pa., recently closed with the Northern Engineering Works, Detroit on a 4-motor 15-ton, crane. Mackintosh, Hemphill Co. recently asked for prices on a 5-ton crane, it has postponed its purchase. The most active line of foundry equipment is molding machines and the inquiries before makers in this district are so numerous that heavy sales are anticipated for the first quarter of 1922 and the general expectation is they will start early in January. The American Locomotive Works which recently equipped its Schenectady and Dunkirk, N. Y., plants with Herman-Pneumatic molding machines, is duplicating this equipment in practically all of its plants which include Richmond, Va., Pittsburgh and Chester, Pa., Paterson, N. J., and Montreal, Quebec. This will place it in position efficiently to distribute its locomotive casting business among its various plants, maintaining uniform molding practice. Other locomotive companies including the Lima Locomotive Works, Lima, O., and the Baldwin Locomotive Works, also are reported to be adding to their molding machine equipment. The National Supply Co., Toledo, O., as well as the Oil Well Supply Co., Oil City, Pa., which recently purchased molding machines are putting out additional inquiries. Several of the radiator and heater manufacturers likewise are said to be interested in molding machines and other foundry equipment. The American Locomotive Works at Chester, Pa., is understood to be reviving its electric furnace inquiry put out several months ago. Prospective foundry equipment purchasers include the Gray Iron Foundry Co., Reading, Pa., and the Pittsburgh Malleable Iron Co.

Dullness Reclaims Chicago Market

IMPROVED demand and better buying of foundry equipment and supplies late in November, which was regarded as a start toward better business, seems to have flattened and the market now is back to the dull level that preceded. However, the flurry, moved some goods and apparently has resulted in considerable prospective business that needs only a slight push in the right direction to convert present inquiry into real buying. Inquiry is not lacking, but is slow to close. The Whiting Corp. has just sold to the International Cement Co., Dunkirk, N. Y., a crane equipped with a 3-yard bucket. Henry E. Pridmore has sold to the Ford Motor Co. a 26-inch combination jolt and power rollover machine.

Occasional Orders in the East

ORDERS for single tools continue to comprise the bulk of current buying in the eastern foundry equipment market. New projects are few, so that the olny real requirements are for replacements and for new contracts which might necessitate the purchase of an additional machine or two, and possibly some supplies. A seasonal development is the receipt of inquiries, issued apparently for obtaining figures for inventory purposes. However, there is an improvement in active demand, due to a quickening in business throughout the metal working industry generally. Of interest to the trade is the report that specifications on work for the New York-New Jersey tunnel will be issued to general contractors around the middle of December. This will be the first definite step in many weeks, and should result in some substantial foundry equipment orders. A current buyer is the American Car & Foundry Co., which is closing on equipment for its plants at Depew, N. Y., and St. Louis. This included a 5-ton electric crane, with 50-foot span, for the former plant, and two 5-ton electric cranes, with 90-foot span, for the latter, the business going to the Pawling & Harnischfeger Co., Milwaukee. The Boynton Furnace Co., Jersey City, has closed on a 1-ton electric crane, with 14-foot span, to the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

The Standard Piston Ring Co., Weatherford, Tex., has been organized by E. A. Frantz, M. D. Akard and others. The company has a capitalization of $10,000.

Capitalized at $1,000,000, the Alberta Foundry & Machine Co., Calgary, Alta, recently was incorporated by Alexander Hannah, Alexander J. Milligan and O. H. E. Wright.

The H. A. May Foundry Co., Philadelphia, recently increased its capital stock from $65,000 to $1,500,000.

The Seneca Falls Foundry Co., Seneca

Falls, N. Y., recently rented the foundry of the Seneca Falls Mfg. Co.

Fink & Olson, 518 Page boulevard, Springfield, Mass., plan the erection of a machine shop and foundry, 30 x 60 feet.

Hedges & Brother, 10 Railroad place, Newark, N. J., manufacturer of valves, etc., have awarded a contract for the erection of a plant building.

Erection of a plant, the first unit of which will be put under construction shortly, is planned by the Coy Valve Co., Inc., Seattle. W. Graham is manager of the company.

The Omaha Semi-Steel Foundry Co., 1409 Jackson street, Omaha, Nebr., is having plans prepared for the erection of a modern plant building to be 60 x 100 feet.

Contracts have been awarded by the Southbridge Foundry Co., Southbridge, Mass., for the erection of a foundry building, 50 x 100 feet.

The J. T. Tice Co., La Grange, Ga., has purchased a site on which it plans the erection of a foundry and machine shop, the main building to be 75 x 175 feet.

Keith Heating Co., 200 Court avenue, Des Moines, Iowa, manufacturer of furnaces and heating equipment, has awarded a contract for the foundation work for its new plant, 100 x 142 feet.

Hancock Steel Co., Martinsburg, W. Va., is building a plant near Hancock, Md. The plant will be 130 x 200 feet, and will be equipped as a machine shop and foundry. F. Vernon Aler is manager of the company.

The Wichita Visible Pump Co., Wichita, Kans., is building a factory building to be devoted to the manufacture of pumps. E. P. Hayes, 701 Gilbert street, Wichita, is general manager.

Contract has been awarded to George Moeller, 3530 Itaska avenue, St. Louis, by the Chester Iron & Foundry Co., 7800 Vulcan street, St. Louis, for the erection of a new foundry building, 45 x 120 feet.

The Eastern Townships Smelting & Refining Co. recently incorporated with $2,000,000 capital stock, has secured options on a site at Shetbrooke, Que., where it plans the construction of a plant.

John A. Moge, Gresham, Oreg., has acquired a site on which he is reported planning the erection of a modern foundry building to be devoted to the production of malleable iron castings.

The Allied Sandblasting Co., New York, recently was incorporated with a capital stock of $25,000, by B. H. Zuckeman and W. R. Fraad. The company is represented by Beran & Fliashnick, 874 Broadway.

Capitalized at $50,000, the Pruyn Bearing Co., New York, recently was incorporated by J. C. Donaldson, S. C. Sawyer and J. E. Pruyn. The company should be addressed 1893 Broadway, New York.

Cooking utensils, novelties, etc., will be made of cast aluminum by the Metal Products Mfg. Co., Portland, Oreg., which recently was incorporated with a capital stock of $100,000. The company plans to buy machinery and equipment in the near future.

The H. C. Decker Machinery Co., Henryetta, Okla., has acquired a 1-acre site on which it is reported planning the erection of a modern machine shop and foundry. The company is capitalized at $75,000. H. C. Decker is president and general manager.

The American Car & Foundry Co., Terre Haute, Ind., has awarded a contract to the Austin Co., 16612 Euclid avenue, Cleveland, for the erection of a plant building, 225 x 260 feet, to replace one damaged by fire some time ago.

To manufacture and deal in pumps and mechanical equipment, the Thomas Pump Co., 27 West Van Buren street, Chicago, recently was incorporated with a capital stock of $10,000, by E. W. Lademan, J. M. Thomas and William S. Jameson.

Engines and motors will be manufactured by the Coremayo Mfg. Co., New York, which was recently incorporated with a capital stock of $250,000, by B. M. Costigan, J. Aguirre and F. C. McGurk. The company is represented by B. B. Avery, 220 Broadway.

Purchase at bankruptcy sale of the Lorain, O., plant of the Aetna Steel Castings Co., by W. W. Davidson of Canton, O., and other Canton and Alliance, O., men recently was made. The plant was bought at $26,000. It has been operating for more than two years.

The Exolon Co., 110 Brookline avenue, Boston, manufacturer of artificial abrasives, operating electric furnace plants at Thorold, Ont, and Blasdell, N. Y., recently resumed the manufacture of its artificial alumina abrasive, which was discontinued about a year ago. The company also produces a carbide-of-silicon abrasive, which is used extensively in the manufacture of grinding wheels and for marble and granite polishing.

Morris W. Bush and associates of Birmingham, Ala., have purchased two pipe plants of the Talladega Foundry & Machine Co. of Talladega, Ala. The properties consist of one small plant, which is now in operation, and a much larger plant of new construction which was operated only a short time and closed when the period of depression set in. The larger plant represents an investment of about $150,000 and is regarded one of the most modern in the South. The plant, it is understood, will be placed in operation in the near future by the new owners.

Machinery and equipment for the factory of the Fordlette Gasoline Engine Co., Huntington, W. Va., have been purchased and capacity production will begin shortly, it was announced recently by E. G. Livezay, president of the company. The company, organized several months ago by Mr. Livezay, inventor of the engine, W. E. Deegans, Dr. C. T. Taylor, and others, will manufacture a 4-horsepower gasoline engine. The engine is intended for use as a marine, farm or concrete mixer power producer. It is expected the factory will be producing at capacity within the next few months.

Operation of the Seymour Laboratoried Units, Inc., 3009 Lisbon avenue, Milwaukee, manufacturer of piston rings and other automobile metal specialties, now is under the direction of Julius J. Goetz, who has been appointed receiver under an order of the Circuit court of Milwaukee county, on petition of the Matthew Addy Co., Cincinnati. The Seymour company was incorporated in Wisconsin in October, 1920, and purchased an existing plant group which was refitted for the manufacture of automobile truck and tractor engine parts, chiefly piston rings. The company is capitalized at $200,000.

A new foundry and pattern storage building, costing in excess of $60,000, has been completed by the Builders' Construction Co. for the C. & G. Potts Co., Washington avenue and Blake street, Indianapolis. The foundry is a model of its kind. It is equipped entirely with new machinery, including a hydraulic elevator and traveling crane. The construction is of steel frame with brick walls and a noncombustible roof. The patterns are stored in a separate 2-story structure. The C. & G. Potts company is one of the oldest foundry and pattern works in Indianapolis, and specializes in the complete design and construction of clay working machinery.

Nozzles, air pumps, rotary geared water pumps, engines, etc., for use in building power spraying machines, are to be manufactured by the Tirrell Mfg. Co., Bridgman, Mich., which recently was incorporated. The company's new plant has been built and equipped and now is operating. The capitalization authorized was $60,000 common and $20,000 preferred stock, of which $43,000 common and $2000 preferred are outstanding. The officers of the company are: President, L. L. Tirrell; vice president, W. H. Gast; and secretary-treasurer, H. E. Howard. These men with the following constitute the board of directors: O. A. D. Baldwin, A. E. Chaunsey, F. C. Stahelin and F. W. Gast.

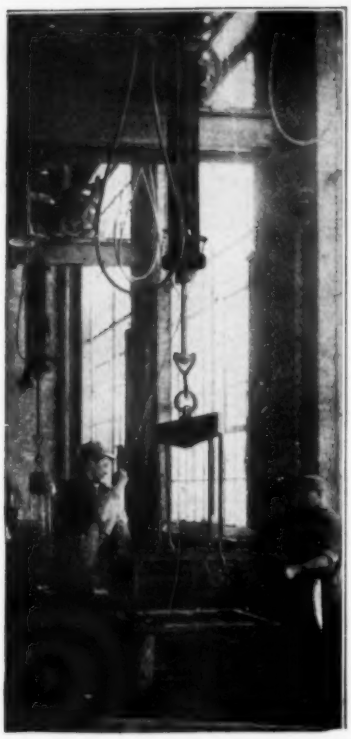
New Trade Publications

STARTERS—The Cutler-Hammer Mfg. Co., Milwaukee, has published a 4-page illustrated folder in which starters for small alternating current motors are described and illustrated. According to the bulletin these motors are suitable for use with motors over a wide range, the contactors being large enough to handle the current for motors of ½ horsepower, 110 volts to 10 horsepower, 440 and 450 volts, the only change being in the thermal element. Complete details are given.

SPRAYS—The Steere Engineering Co., Detroit, is circulating an illustrated folder in which a liquid spray is described and illustrated. According to the folder this spray was designed with the purpose of avoiding high pressure at the nozzle to provide nozzles with full, clear openings to deliver the sprayed liquid in the form of small globules of sufficient dimension and weight that they will not "carry over" with the gas and to uniformly distribute the sprayed liquid over the cross section of the apparatus.

UNIVERSAL VISE—The Oliver Machinery Co., Grand Rapids, Mich., has published a 4-page illustrated folder in which a universal vise for patternmakers and woodworkers is described and illustrated. The jaws of this vise are 7¼ inches wide, 18 inches long and will open up to 16 inches. It is of strong construction, heavy ribs to the corners of the jaws, also to the center of clamping strain point, assure rigidity and holding power the whole length of the jaw. The screw is of steel 1⅛ inches diameter with buttress thread, with a self-centering and detachable nut, which can be easily removed.

ELECTRIC FURNACE — The Repel-Arc Furnace Co., Indianapolis, is circulating a 4-page illustrated folder in which an electric furnace is described and illustrated. Essentially this furnace consists of a metal framework, supporting a furnace bowl and a mast which carries the electrode holder or torch. The frame is of standard shapes riveted together. No foundation is required except in the larger sizes. The bowl is of boiler plate with riveted seams. It is mounted on trunnions and can be tilted for pouring. Small furnaces are tilted by hand while the larger ones are operated by motor and screw. The torch consists of a cylinder with one end closed, made of crucible material. Through the closed end are three round holes in which are placed cast alloy supports for the carbons or electrodes. The three electrodes each are carried in a sleeve which rests on the support so as to be pivoted or free to swing. They are counter-weighted so that the lower end swings into contact when the current is off. This makes the furnace self-regulating. Other details are given.



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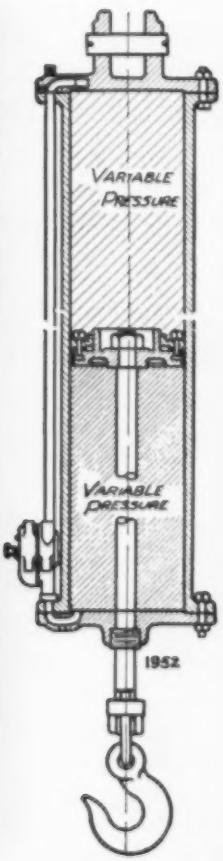

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ABRASIVE WHEELS
Carborundum Co., The, Niagara Falls, N. Y.

ABRASIVES (Metallic)
Globe Steel Co., Mansfield, Ohio.
Hoevel Mfg. Corp.,
154 Ogden Ave., Jersey City, N. J.
Metallic Abrasive Sales Co.,
403 Home Trust Bldg., Pittsburgh, Pa.
Pangborn Corp.,
P. O., Box 851, Hagerstown, Md.
Pittsburgh Crushed Steel Co., Pittsburgh, Pa.
Steel Shot & Grit Co., Inc., Amesbury, Mass.

ACETYLENE GENERATORS
Air Reduction Co., 342 Madison Ave., N. Y.
Imperial Brass Mfg. Co.,
1200 W. Harrington St., Chicago, Ill.

ACETYLENE IN CYLINDERS
Air Reduction Co., 342 Madison Ave., N. Y.
Oxweld Acetylene Co., Newark, N. J.

AIR COMPRESSORS
Bury Compressor Co.,
18th and Raspberry Sts., Erie, Pa.
Chicago Pneu. Tool Co.,
6 E. 44th St., N. Y.
Curtis Pneumatic Machinery Co.,
1501 Kienlan Ave., St. Louis, Mo.
Deane Steam Pump Plant, Holyoke, Mass.
Gardner Governor Co., The, Quincy, Ill.
Griscom-Russell Co., The,
90 West St., New York.
Ingersoll-Rand Co., 11 Broadway, N. Y. C.
Sullivan Machinery Co.,
122 S. Michigan, Chicago.
Westinghouse Traction Brake Co.,
Wilmerding, Pa.

AIR SEPARATORS—See SEPARATORS (Air—Moisture)

AIR TOOLS—See TOOLS (Pneumatic)

AIR TRAPS
Ohio Body & Blower Co., The, Cleve. O.

ALLOYS
Alloys & Products, Inc.,
1448 West Farms Road, New York, N. Y.
Hoskins Mfg. Co.,
453-71 Lawton Ave., Detroit.
Keokuk Electro-Metals Co.,
1518 Corn Exchange Bank Bldg., Chicago.
Titanium Alloy Mfg. Co.,
Niagara Falls, New York.

ALUMINUM
Rogers, Brown & Co.,
Room 1942, 30 Church St., N. Y. City.

ANNEALING OVENS—See OVENS (Annealing)

ARCHITECTS (Industrial)
Mills, Rhines, Bellman & Nordhoff,
1234 Ohio Bldg., Toledo, Ohio.
Sly, W. W., Mfg. Co.,
4702 Train Ave., Cleveland.

BABBITT HEATERS (Electric)
Volta Mfg. Co., Ltd., The, Welland, Ont., Can.

BABBITT METAL
Ajax Metal Co., Philadelphia, Pa.
Hoyt Metal Co.,
Boatmen's Bank Bldg., St. Louis, Mo.

BANDS, SNAP FLASK (Steel)
Truscon Steel Co., Youngstown, Ohio.

BARROWS (Foundry)
Akron Barrow Co., The,
3140 E. 65th St., Cleveland, Ohio.
Penn Foundry & Mfg. Co., Reading, Pa.
Sterling Wheelbarrow Co.,
64th Ave., Milwaukee.

BARS (Iron and Steel)
Bethlehem Steel Co., Bethlehem, Pa.
Truscon Steel Co., Youngstown, Ohio.

BEARINGS (Crane)
Hyatt Roller Bearing Co.,
709 Sixth Ave. at 41st St., New York, N.Y.

BEARINGS (Hoist)
Hyatt Roller Bearing Co.,
709 Sixth Ave. at 41st St., New York, N.Y.

BEARINGS (Roller)
Hyatt Roller Bearing Co.,
709 Sixth Ave. at 41st St., New York, N.Y.

BEARINGS (Steel Mill Equipment)
Hyatt Roller Bearing Co.,
709 Sixth Ave. at 41st St., New York, N.Y.

BEARINGS (Trolley)
Hyatt Roller Bearing Co.,
709 Sixth Ave. at 41st St., New York, N.Y.

BELLOWS (Molders)
Kelly, T. P., & Co., Inc.,
355 West 26th St., New York, N. Y.
Osborn Mfg. Co.,
5401 Hamilton Ave., Cleveland.
Paxson, J. W., Company,
1021 N. Delaware Ave., Philadelphia.
Pettinos, George F.,
Real Estate Bldg., Philadelphia.

BENCHES (Pattern Makers)
Diamond Clamp & Flask Co.,
38 N. 14th St., Richmond, Ind.

BINDERS (Sand)
Mifflin Chemical Corp.,
Delaware Ave. & Tasker St., Philadelphia.
Paxson, J. W., Co.,
1021 N. Delaware Ave., Philadelphia, Pa.

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Ohio Body & Blower Co., The, Cleveland.

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CARBONIZING FURNACE LINING
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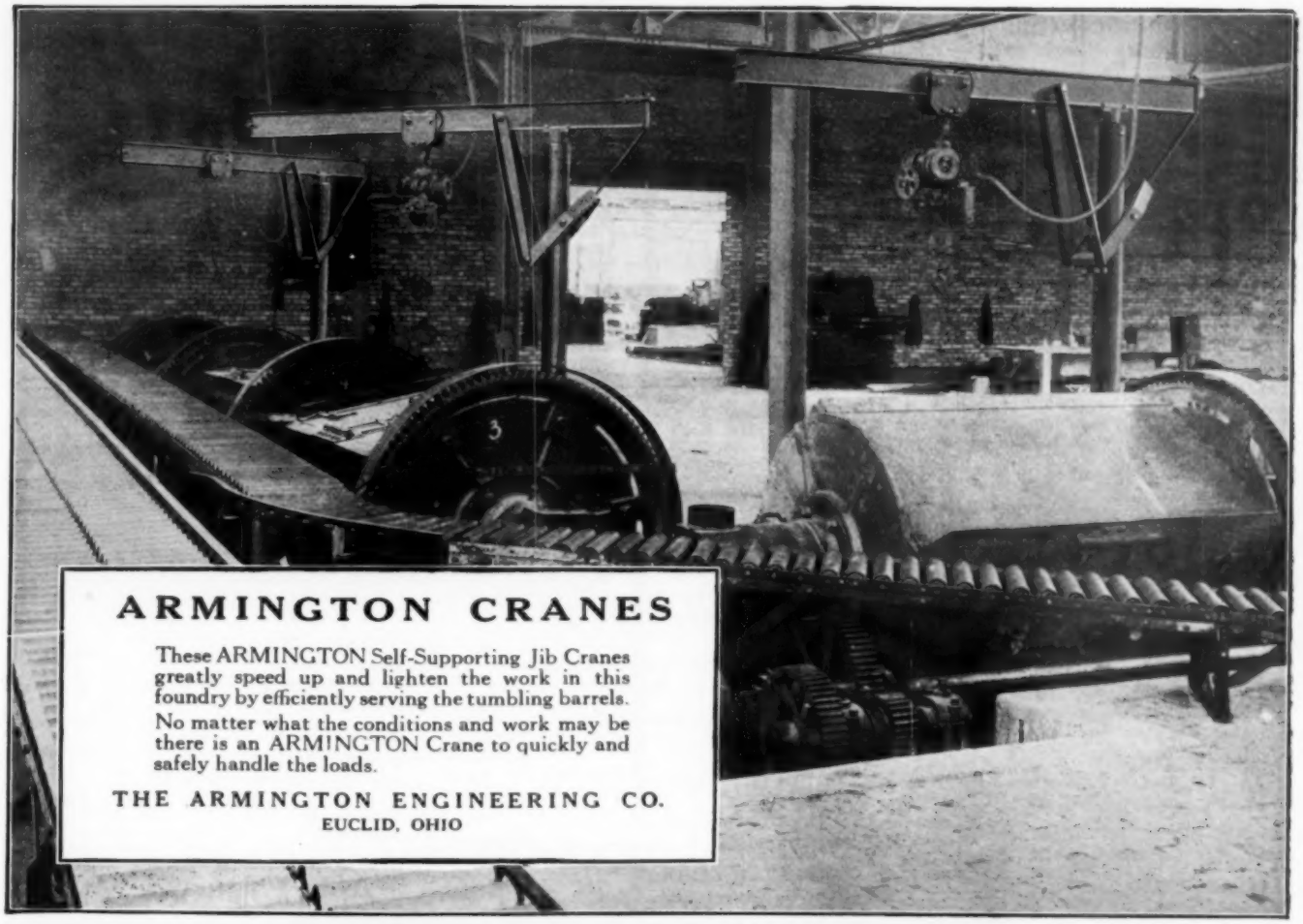

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COMPRESSORS (Gas)
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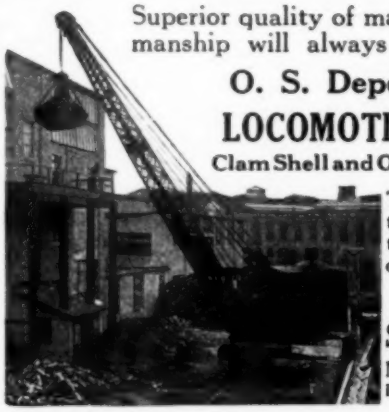

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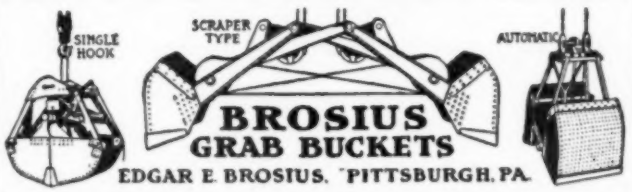

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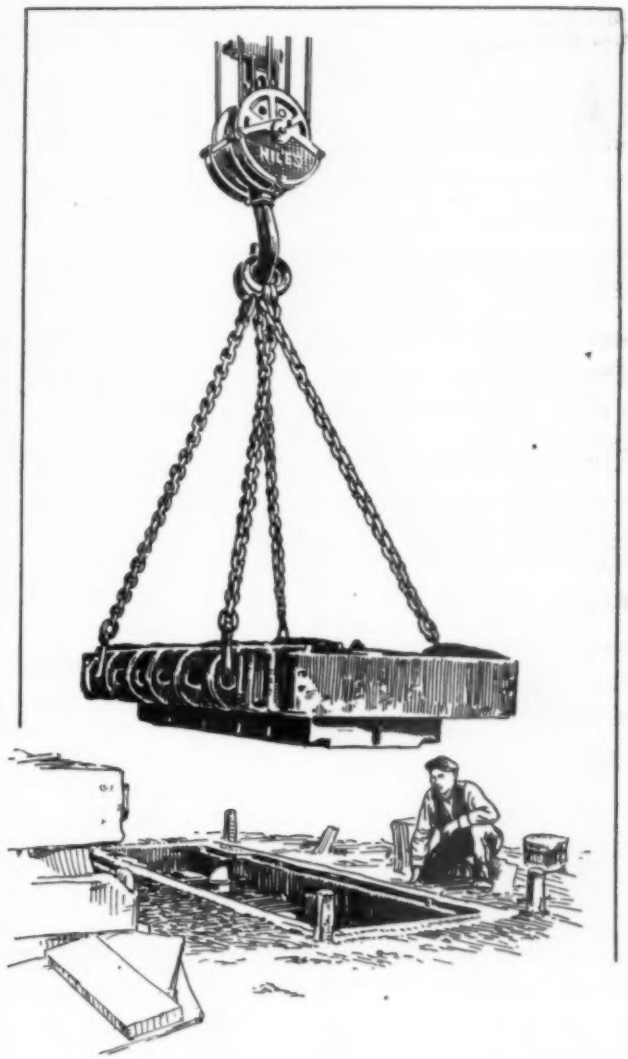

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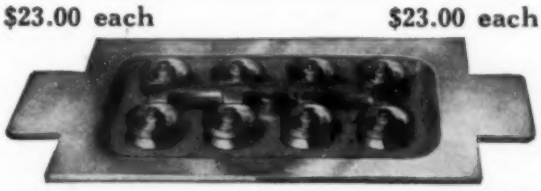

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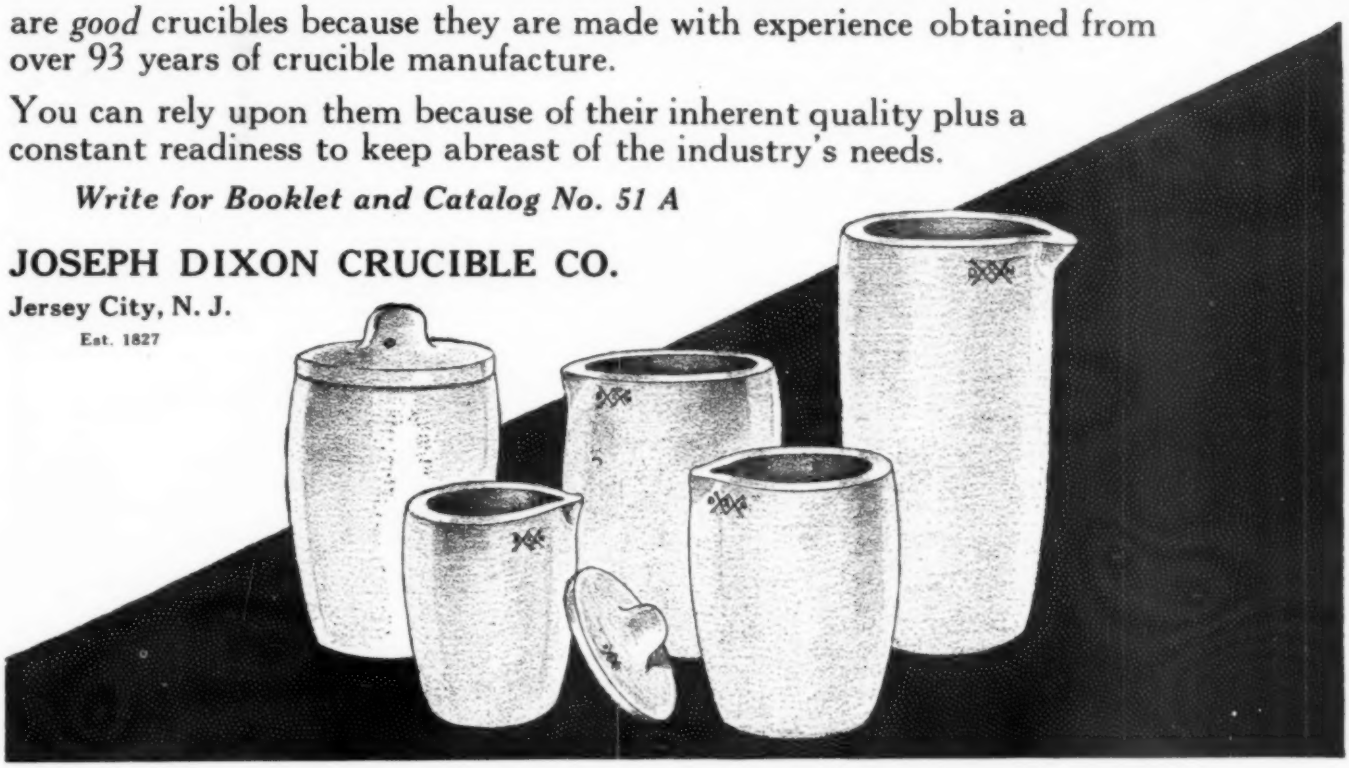

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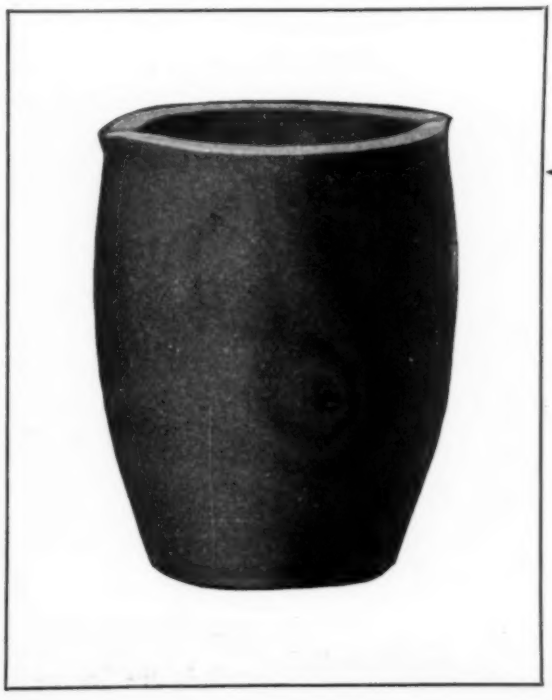

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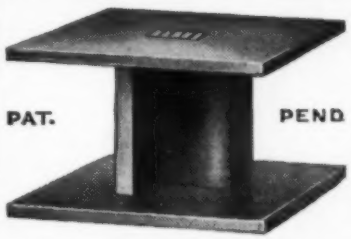

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Paxson, J. W., Co., Philadelphia, Pa.
Pettinos, Chas. E., 25 Church St., N. Y.
Pettinos, Geo. F., Real Estate Trust Bldg., Philadelphia, Pa.
Stevens, Frederic B., Detroit, Mich.
Swan & Finch Co., 165 Broadway, New York, N. Y.

PARTITIONS (Rolled Steel)
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Paxson, J. W., Co, Philadelphia, Pa.

PATTERN LUMBER
Thompson, Lewis & Co., Inc., 1109 Colonial Trust Bldg., Phila., Pa.

PATTERN PLATES
Ashland Brass Foundry, Virginia Ave., Ashland, Ohio.
Moltrup Steel Prod. Co., Beaver Falls, Pa.

PATTERN SHOP SUPPLIES
Diamond Clamp & Flask Co., 38 N. 14th St., Richmond, Ind.
McCormick, J. S., Co., 2428 Railroad St., Pittsburgh, Pa.
Paxson, J. W., Co, Philadelphia, Pa

PATTERN WAX
United Compound Co., 228 Elk St., Buffalo, N. Y.

PATTERNS (Wood and Metal)
Arcade Mfg. Co., Dept. D., Freeport, Ill.
Barrett, J. C. Company, 516 Asylum St, Hartford, Conn.
Bryan Pattern & Machine Co., The, Bryan, Ohio.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh, Pa.

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Bethlehem Steel Co., Bethlehem, Pa.
Hanna & Co., M. A., Leader-News Bldg., Cleveland.
Pil.ing & Co., Philadelphia, Pa.
Rogers, Brown & Co., Cincinnati, O.

PIG IRON CONVEYORS (Gravity)
Mathews Gravity Carrier Co., 104 10th St., Ellwood City, Pa.

PIG IRON (Charcoal)
Salisbury Iron Co., Lime Rock, Conn.

PIG IRON (Vanadium)
Thomas Iron Co., The, Hokendauqua, Pa.

PINCH DOGS
Diamond Clamp & Flask Co., 38 N. 14th St., Richmond, Ind.

PLATES (Bottom Snap Flask)
Diamond Clamp & Flask Co., 38-40 No. 14th St., Richmond, Ind.
Truscon Steel Co., Youngstown, Ohio.
Wadsworth Core Mach. & Equip. Co., The, Akron, Ohio.

PLATES (Circular and Disc, Steel)
Moltrup Steel Prod. Co., Beaver Falls, Pa.
Truscon Steel Co., Youngstown, Ohio.

PLATES (Core Drying)
Wadsworth Core Mach. & Equip. Co., The, Akron, Ohio.
Truscon Steel Co., Youngstown, Ohio.

PLATES (Grinding Wheel Steel)
Moltrup Steel Prod. Co., Beaver Falls, Pa.

PLATES (Rapping)
Diamond Clamp & Flask Co., 38 N. 14th St., Richmond, Ind.
Paxson, J. W., Co., 1021 N. Delaware Ave., Philadelphia, Pa.

PLATES (Steel Pattern)
Moltrup Steel Prod. Co., Beaver Falls, Pa.
Truscon Steel Co., Youngstown, Ohio.

PLUMBAGO
Dixon, Jos., Crucible Co., Jersey City, N. J.
Kelly, T. P., & Co., Inc., 355 West 26th St., New York, N. Y.
Paxson, J. W., Co., Philadelphia, Pa.
Pettinos, Chas., 25 Church St., N. Y. C.
Pettinos, George F., Real Estate Bldg., Phila.
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PLUMBAGO (Nozzles, Sleeves, Stoppers)
Ross-Tacony Crucible Co., Tacony, Phila.

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Stevens, Frederick B., Detaroit, Mich.

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Porcelain Enamel Mfg. Co., The, Eighth and O'Donnell Sts., Baltimore, Md.

PORCELAIN ENAMELING (Practical Service)
Porcelain Enamel & Mfg. Co., The, Eighth and O'Donnell Sts., Baltimore, Md.

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POWDERED COAL PLANTS
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Quigley Furnace Spec. Co., 26 Cortlandt, New York

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Truscon Steel Co., Youngstown, O.

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Dings Magnetic Separator Co., 675 Smith St., Milwaukee, Wis.

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Gardner Governor Co., The, Quincy, Ill.

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Gardner Governor Co., The, Quincy, Ill.

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Ingersoll-Rand Co., 11 Broadway, N. Y. C.

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Gardner Governor Co., The, Quincy, Ill.

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Hoskins Mfg. Co., 453-71 Lawton Ave., Detroit.

RAMMERS (Sand Pneumatic)—See SAND RAMMERS (Pneumatic)

RESPIRATORS
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Malleable Iron Fittings Co., Branford, Conn.
Paxson, J. W., Company, 1021 N. Delaware Ave., Philadelphia.
Pettinos, Chas. E., 25 Church St., N. Y. C.
Pettinos, George F., Real Estate Bldg., Philadelphia.

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ROLLER BEARINGS
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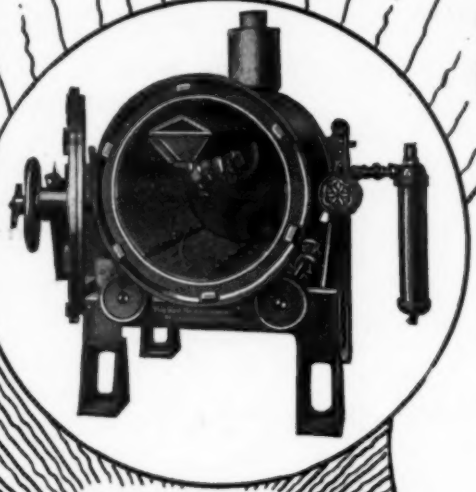
SAFETY GOGGLES
Wilson Goggles Inc., Reading, Pa.



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Standard Sand & Machine Co., Cleveland.
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Portage Silica Co., The, Youngstown, Ohio.
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Metallic Abrasive Sales Co.,
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Pettinos, Chas., 25 Church St., New York.
Pettinos, Geo. F.,
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Pangborn, Corp.,
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Paxson, J. W., Co.,
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Pettinos, Chas., 25 Church St., N. Y. C.
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Paxson, J. W., Co.,
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Pettinos, Chas., 25 Church St., New York.
Portage Silica Co., Youngstown, O.
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Globe Steel Co., The, Mansfield, Ohio.
Hoevel Mfg. Corp.,
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Metallic Abrasive Sales Co.,
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Mott Sand Blast Mfg. Co.,
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New Haven Sand Blast Co.,
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Pangborn Corp.,
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Pittsburgh Crushed Steel Co., Pittsburgh, Pa.
Steel Shot & Grit Co., Inc., Amesbury, Mass.
U. S. Silica Co.,
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Metallic Abrasive Sales Co.,
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Steel Shot & Grit Co., Inc., Amesbury, Mass.

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New Haven Sand Blast Co.,
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Pangborn Corporation, P. O. Box 851,
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Paxson, J. W., Co.,
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Phoenix Machine Co., Inc.,
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4702 Train Ave., Cleveland.
Tilghman-Brookshank Sand Blast Co., The,
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SAND BLAST NOZZLES—See NOZZLES (Sand Blast)

SAND BLAST SHOT (Steel)—See SHOT (Steel Sand Blast)

SAND BLAST TUMBLING BARRELS—See TUMBLING BARRELS

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Whiting Corp., Harvey, Ill.

SAND DRYERS
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Hoevel Mfg. Corp.,
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Pangborn Corporation, P. O. Box 851,
Hagerstown Md.

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National Engineering Co.,
549 W. Washington St., Chicago, Ill.

SAND HANDLING EQUIPMENT
Bartlett, C. O., & Snow Co., Cleveland.
Link-Belt Company, Chicago, Ill.
National Engineering Co.,
Machinery Hall Bldg.,
549 W. Washington St., Chicago, Ill.
Standard Sand & Machine Co., Cleveland.

SAND MIXING MACHINERY
National Engineering Co.,
Machinery Hall Bldg.,
549 W. Washington St., Chicago
Standard Sand & Machine Co., Cleveland

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Chicago Pneumatic Tool Co.,
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Cleveland Pneumatic Tool Co.,
3734 E. 78th St., S. E. Cleveland, O.
Ingersoll-Rand Co., 11 Broadway, N. Y. C.
Oldham, Geo., & Son, Co.,
Scott and McHenry Sts., Baltimore, Md.

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National Engineering Co.,
Machinery Hall Bldg.,
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Herman Pneumatic Machine Co.,
Union Bank Bldg., Pittsburgh, Pa.
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National Eng. Co., Machy. Hall Bldg.,
549 W. Washington St., Chicago, Ill.
Paxson, J. W., Company,
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Standard Sand & Machine Co., Cleveland.

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Truscon Steel Co., Youngstown, O.

SASH (Steel) See STEEL SASH

SCREENS (Sand)
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Standard Sand & Machine Co., Cleveland.

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Stevens, Frederic B., Detroit, Mich.

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SEPARATORS (Sand)
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SHAFTING HANGERS (Roller Bearing)
Hyatt Roller Bearing Co.,
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Metallic Abrasive Sales Co.,
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Steel Shot & Grit Co., Inc., Amesbury, Mass.

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Williams & Co., Inc.,
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SHOT (Nickel Melting)
Williams & Co., Inc.,
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SHOT (Steel Sand Blast)
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Metallic Abrasive Sales Co.,
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New Haven Sand Blast Co.,
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Paxson, J. W., Co.,
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Pittsburgh Shovel Co., Pittsburgh, Pa.
Wood Shovel & Tool Co., The, Piqua, Ohio.

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Dings Magnetic Separator Co.,
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SILICA GANISTER
Kenyon Brothers, Edge Hill, Pa.

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Portage Silica Co., Youngstown, O.

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Truscon Steel Co., Youngstown, Ohio.

SNAP FLASK BOTTOM PLATES—See PLATES (Bottom Snap Flask)

SNAP FLASK TRIMMINGS
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SNAP MOLD JACKETS—See JACKETS (Snap Flask Mold)

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Truscon Steel Co., Youngstown, O.

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Niles-Bement-Pond Co.,
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Northern Engineering Works,
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Paxson, J. W., Co.,
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Whiting Corporation, Harvey, Ill.

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Constructional Engineering Co., Ltd., Titan Works,
Charles Henry St., Birmingham, Eng.

TURBO BLOWERS—See BLOWERS

TURNTABLES
Whiting Corporation, Harvey, Ill.

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Westinghouse Traction Brake Co.,
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Powell, Wm., Co., The, Cincinnati, O.

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STYLES A, G, and AA

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Style A Equipped with 6" x 1" face; "AA" 6" x 1¼" face Emery Wheels.

The Throttle and Forward Handles are in alignment, balancing machine on center, insuring perfect control and permitting operator to regulate speed or shut off air power without removing his hand from throttle. Adapted to Grinding Castings, Polishing, Buffing, etc. Fitted with wheel guards if required.—Style A—Fitted with Pistol-Grip Handle if preferred.

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Consult us any time—Perhaps we can be of service in suggesting a shovel better suited for your particular requirements.

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A MOLASSES BINDER

OLD-Fashioned Molasses brought up-to-date, that's

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More binding power than ever

It can be left standing for days as a diluted wash without deteriorating.

By actual test CORE-MOL is 25% stronger in adhesive qualities when mixed with sand.

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Dept. A

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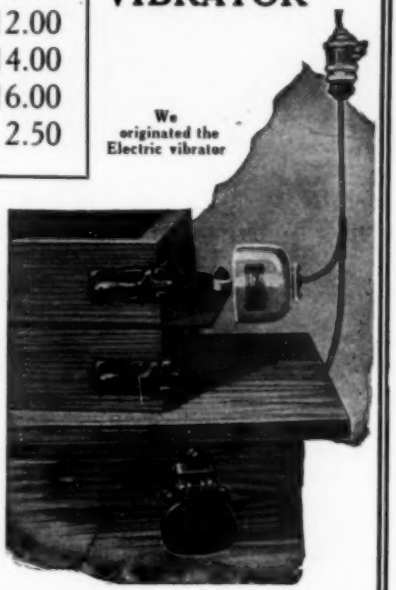
We originated the Electric vibrator



"L & A" Vibrators are attached directly to an ordinary light line and are operated by a knee switch.

The cost of maintenance is practically nothing—the cost of operation being less than a cent a day.

Take advantage of our *ten day trial offer* and learn at our expense how one vibrator can *speed up your foundry production and reduce costs.*

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The power behind the stroke is what makes *Oldham Hammers* the universal favorite in the most efficient plants. They are scientifically constructed to be powerful, durable and economical.

Oldham Hammers are available in eight sizes. There is a size that will increase the speed of your workmen.

Are you using *Oldham Core Busters, Oldham Bench Rammers, Oldham Floor Rammers and Oldham Hammers?* If not,

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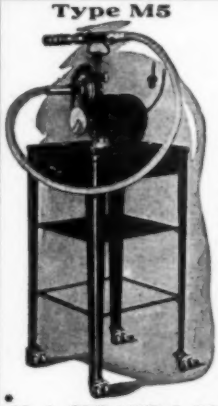

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This Type M5 will be very much appreciated by your workmen in the pattern shop. They can grind, polish, scrape, drill, scratch, brush and do many jobs with this outfit when fully equipped with attachments.

For Pattern Makers use attach to lamp socket. All ready for use.

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CABLE 5 FT. 6 IN. LONG

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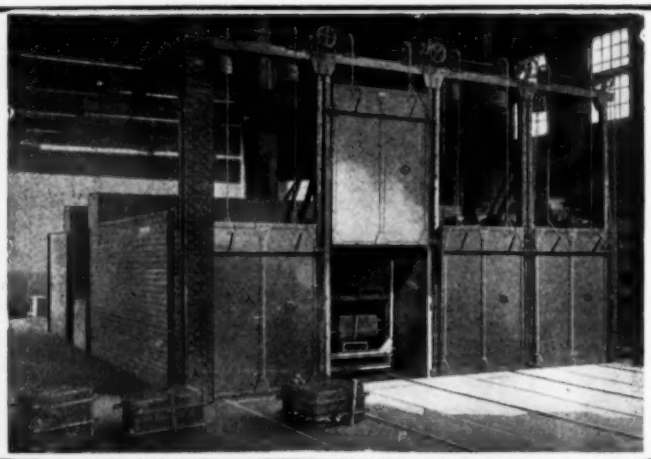

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are the choice of leading foundries everywhere. Hundreds of successful installations during our seventeen years of experience.

Coleman Ovens are built in all types—rolling drawer, car, shelf and portable rack ovens. Any fuel—coke, oil, gas, etc.

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STEEL CHANNEL STAVE
WOOD STAVE, STEEL LINED

DOUBLE EXHAUST
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When in the market for Tumbling Equipment consult HENDERSON for recommendations and layout. Backed by years of experience we can supply the proper barrel for all contingencies.

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Ask Any User He Knows

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AIR POWER FOR SMALLER FOUNDRIES

There's a Sullivan Compressor for the smaller foundry, using only a few air tools, as well as for large plants—

Here's one, a

SULLIVAN "WG-6"

single stage, belted to motor by compact short center drive.

You can depend on this machine to run right and to run all the time, because it is designed and built with the same care in choosing materials and in construction which marks all Sullivan Air Compressors.

Wafer air valves secure excellent efficiency.

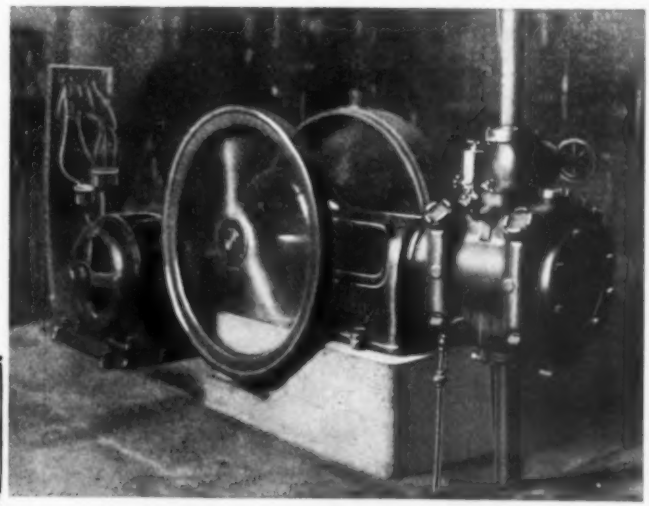
Inlet valve unloader saves power.

Tight housings protect working parts from dirt and chips.

Splash lubrication renders the Compressor almost automatic.

Capacities:—50 to 450 cu. ft.

Bulletin 1875-R.



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Turbo-Compressors

Inlet End No. 1050
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"Spencer" Dependability Eliminates Delay

Delays caused by breakdowns and failures in air pressure, though costly, are practically unnecessary. Due to extremely wide clearances between all stationary and moving elements, and to the absence of gears or belts, the **Spencer Turbo-Compressor** maintains its efficiency permanently. It is sturdy and rugged, and thoroly reliable.

Dependability and Service are "built-in" qualities of the **Spencer Turbo-Compressor**. Over fifteen years experience in the design and manufacture of turbine compressors has placed the **"Spencer"** in the foreground of the industry.

Spencer Turbo-Compressors operate at low speed and furnish constant pressure free from surgings or pulsations.

Solve your problem the "Spencer" way.

The Spencer Turbine Company
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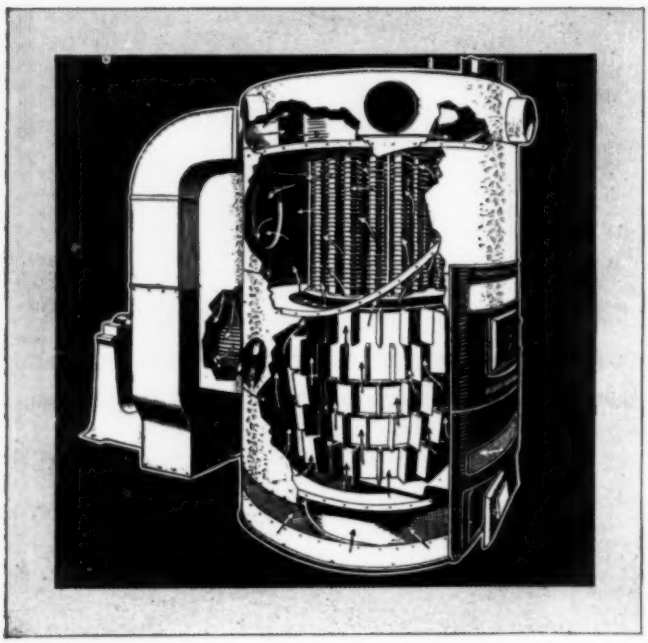
Summer Climate
Shipped To-day

No need to let frozen sand and numb-fingered, grumpy moulders chase costs up the ladder. The cheapest foundry heat in the world—the Gordon Mechanical Hot Blast Heater—can be shipped to-day and be heating your plant to comfort as soon as it arrives. Wire for summer climate.



THE Gordon Mechanical Hot Blast Heater gets twice as much heat from a pound of coal as any other type. Multi-vane fan gives $3^1/_3$ times as many hourly air changes as similar units. Unit capacities 100,000 to 500,000 cubic feet of space. Hundreds in use. Wire—

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Specialists in Heating and Ventilating

Hearty co-operation with architects and engineers on any problem in heating, ventilating, air conditioning, process piping, power plants.

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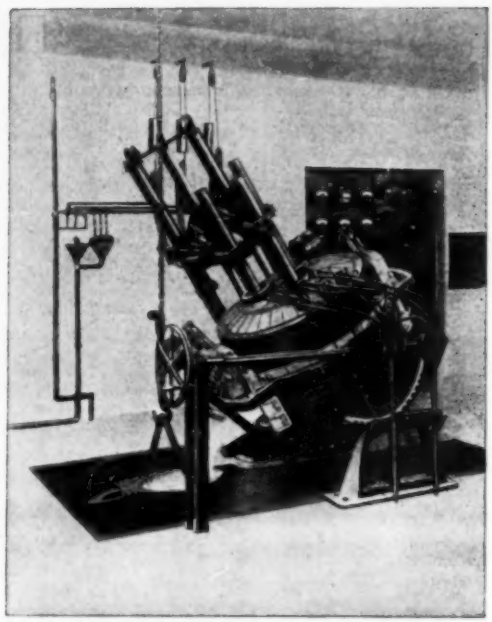
Lectromelt



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Simplicity and Ruggedness of Design Characterize the *'LECTROMELT* Furnace

There is no complicated operating mechanism — all parts subjected to great wear and strain are made strong and durable by the use of the best material obtainable and by the practice of the most careful design.

Our catalogue describes all of these features and many others in complete detail—send for your copy today.

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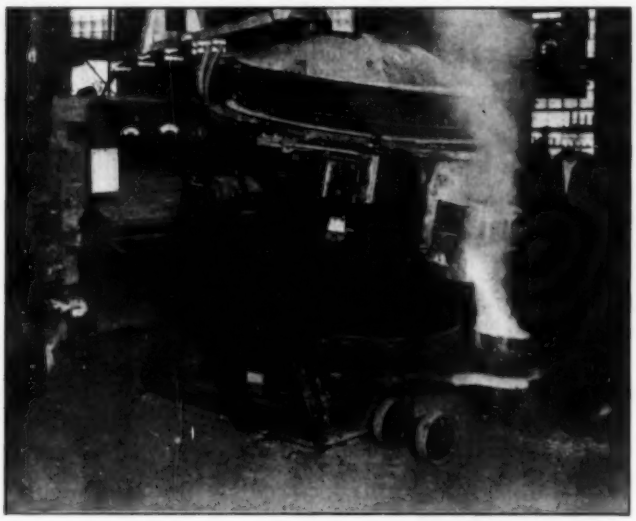
Costs in Your Brass Foundry



Fuel, labor, metal loss, etc., are subjects of importance to foundries which must sell their products at present competitive prices.

For this reason we have prepared a timely folder which shows how many leading plants, throughout the United States and Canada, have lowered the cost of producing brass castings.

While the present edition lasts we shall gladly mail a copy, upon request.

"Costs in Your Brass Foundry" is listed as Folder 12-B.

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BOOTH
Rotating Electric Furnace

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MAXON PREMIX BURNERS

BURN GAS OR OIL

They are complete motor driven **FUEL BURNING UNITS** supplying the air and fuel intimately mixed so that complete combustion is secured.

APPLICABLE TO ALL INDUSTRIAL FURNACES

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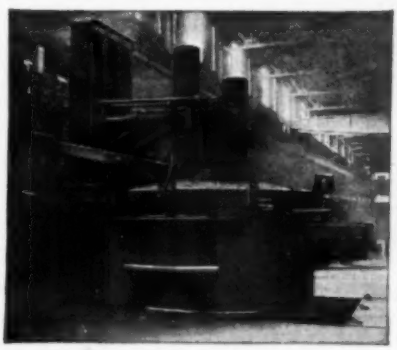
Electric Furnaces



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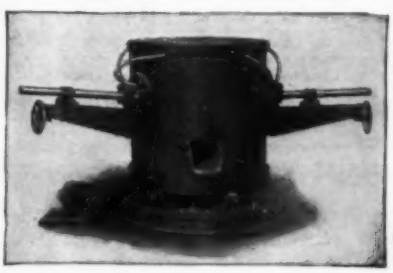
In sizes to suit customer.



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Now, When You Want a Few Castings in a Hurry—

This cupola plant will enable you to make them *at a profit.*

Designed for emergency or temporary use, during relining or breakdown of cupola. Increases your output. Helps to get out small rush jobs. Just the thing for experimental work.

Three Standard Sizes

Size	Melting Capacity Per Hour Pounds	Kilograms
No. 1	1120	508
No. 2	1680	762
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We also make

Improved rapid melting cupolas of any size, charging devices and platforms, Runways, Crane and Pressed Steel Ladles. We build and completely equip foundries all over the world. Constructional steel-work of every description.

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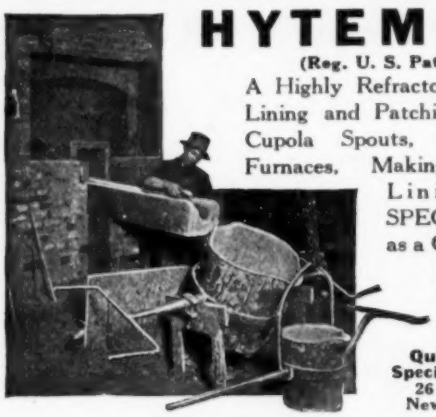

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Crushed Silica Ganister

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Used in making a mortar or cement for laying up fire brick and mica-schist.

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For Iron and Steel Melting and Refining

SIZES—½—¼—½—1½—3—6—12—25 TONS

Scientifically shaped for uniform heat distribution.
Preheating scrap—cupola duplexing.
Better electric grey iron cheaper than from cupola alone.

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Will save you 200% over any other refractory For furnace linings.

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"GREAVES-ETCHELLS" for melting and refining Iron and Steel.
FAST MELTING ACID LINED FURNACES.
ELECTRICALLY HEATED:—Core and Mold Drying Ovens. Vitreous Enameling and Japanning Ovens.
HEAT TREATING FURNACES for brass, iron and steel.

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To FOUNDRYMEN who make high grade MANGANESE BRONZE CASTINGS:

CUT YOUR METAL COST by using "ALPRO" HARDENER

"ALPRO" HARDENER WILL ENABLE YOU TO MAKE MANGANESE BRONZE AT A COST OF AT LEAST **20% LESS** THAN A HIGH GRADE MANGANESE BRONZE INGOT CAN BE BOUGHT FOR.

"ALPRO" HARDENER WILL ENABLE YOU TO GET **80,000 LBS. PLUS, TENSILE** WITH GOOD ELONGATION. Or, **45% PLUS, ELONGATION** WITH GOOD TENSILE STRENGTH. IT IS A "FOOL-PROOF" PRODUCT, AND CAN BE MANIPULATED TO GET A VARIETY OF EFFECTS.

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Specialists in Alloys of ALUMINUM — BRONZE — COPPER — NICKEL

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Made in all standard grades in SHOT or waffle form.

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The beneficial influence of NICKEL and CHROMIUM in Iron Castings is universally recognized.

MAYARI PIG IRON contains these alloys naturally and is the best method of adding Nickel and Chromium. Attempts made to introduce Nickel and Chromium through the use of Metallic Nickel and Ferro-Chromium to the cupola charge have resulted in high oxidation loss and lack of uniformity in the castings.

MAYARI PIG IRON melts readily at cupola temperatures and produces an iron with "longer fluidity" than is generally the case with low phosphorus castings.

MAYARI PIG IRON produces a metal particularly free from oxidation.

MAYARI PIG IRON is regularly furnished in silicons from .25% to 3.00%. Phosphorus below .09% and Sulphur below .04%.

MAYARI PIG IRON in motor cycle cylinders, one manufacturer reports, produces a harder and therefore, better wearing casting but, in spite of this, machining is aided to such an extent that these castings are bored with one-half the tool grinding that was necessary when using straight grey iron castings.

MAYARI PIG IRON reduces cost in the manufacture of high-grade castings for many purposes.

Mayari Motor Cylinders show no wear at 45,000 miles

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As Hiram said when he saw the giraffe: "There ain't no such animile" as cheap fuel nowadays. Right—but less fuel per heat would bring fuel costs to the old figures, wouldn't it?

Ajax Process Ingots melt more quickly than new metals and eliminate the necessity for remelting a large percentage of defectives; use less fuel and thus bring down your costs per perfect casting.

"It's All in the Ajax Process"

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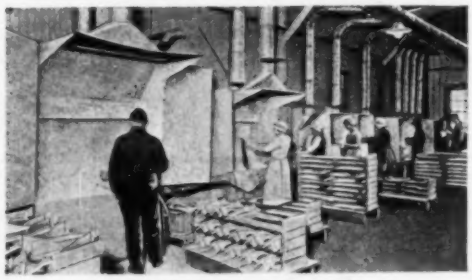
AJAX PROCESS INGOTS

Porcelain Enameling on CAST IRON



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